

# Nuytsia

WESTERN AUSTRALIAN HERBARIUM  
VOLUME 28 2017



Department of Biodiversity,  
Conservation and Attractions

The cover of Volume 28 of *Nuytsia* features a stunning photograph of Fortescue Marsh, a nationally significant, ephemeral wetland set between the Chichester and Hamersley Ranges in the Pilbara region. The marsh is rich in plant and animal species of high conservation value, including unique samphire communities. Photograph: Steve Dillon.

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AND ATTRACTIONS  
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## *Nuytsia*

*Nuytsia* is a peer-reviewed journal that publishes original papers and short communications on the systematics, taxonomy and nomenclature of Australian (particularly Western Australian) plants, algae and fungi.

Descriptions of taxa, revisions, identification guides, nomenclatural and taxonomic issues, systematic analyses and classifications, censuses, and information on invasive species are all considered.

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## Allan Cunningham and the Boab (*Adansonia gregorii*; Bombaceae)

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### Abstract

Orchard, A.E. Allan Cunningham and the Boab (*Adansonia gregorii*; Bombaceae). *Nuytsia* 28: 1–9 (2017). The Australian Boab, now known as *Adansonia gregorii* F.Muell. was first noticed botanically by Allan Cunningham during Phillip Parker King's second survey voyage in 1819, and first collected by Cunningham in the following year at Careening Bay. Cunningham saw only fruiting material, and considered the tree to belong to the genus *Capparis* L., giving it the manuscript name *C. gibbosa* A.Cunn. He described but did not formally name the species in King's *Narrative of a Survey*. The name was published with a valid description in Heward's biography of Cunningham in 1842. In the interim Cunningham had drafted a paper comparing his species with the African genus *Adansonia* Juss., but unfortunately never published it. Subsequently Mueller described the species again, as *A. gregorii* F.Muell., based on specimens collected near the Victoria and Fitzmaurice Rivers, and this name became accepted for the species. In 1995 Baum recognised that the two descriptions referred to the same taxon, and made the combination *Adansonia gibbosa* (A.Cunn.) Guymer ex D.Baum. A subsequent referral to the Spermatophyta Committee and General Committee resulted in the name *C. gibbosa* being rejected, on the grounds that 'it seems unlikely that... Cunningham had any intention that this [Heward's] description should validate the name of a new species.' Recent rediscovery of Cunningham's draft paper shows that, on the contrary, Cunningham clearly believed that his name *C. gibbosa* was suitable for acceptance, and according to the practices of his day, should be published. That his premature death and subsequent unrecognised description of the species in Heward's paper resulted in his discovery going unacknowledged, and being overtaken by Mueller's later description, is unfortunate, but now irreversible.

### Introduction

*Adansonia gregorii* F.Muell., is one of Australia's most readily recognised trees (Figure 1, 2). It is widespread in the Kimberley region of Western Australia, extending into the adjacent western Northern Territory. This paper traces its discovery by Allan Cunningham, his work towards its description, and its subsequent nomenclatural history.

### History of discovery and nomenclature

This species first came to botanical attention during the second of Phillip Parker King's survey voyages in the *Mermaid* in 1819. King was accompanied by the botanist Allan Cunningham, attached to the voyage on the recommendation of Sir Joseph Banks. Cunningham first saw the Boab at Still Bay in the West Arm of Cambridge Gulf on 22<sup>nd</sup> September 1819, when he described seeing 'The large Gouty Tree observed on the shore of the large Island without leaves, I found bearing fruit at the Extremities of



Figure 1. *Adansonia gregorii*. A – habit; B – fruit, with senescing leaves. Photographs by A.E. Orchard taken at Sheep Island, Camden Harbour, 27 April 2016 (A) and Vansittart Bay, 24 April 2016 (B).

the branches, which I with some Difficulty gather'd. It proves to be a *Capparis*, No. 251 seed list. The wood is soft succulent & spongy, of even arborescent habit of growth.' It seems from this description that he did not collect botanical specimens, only seeds.

The following year, during King's third survey voyage, Cunningham saw the tree again at a number of sites, without making collections, until the expedition was obliged to spend 18 days at Careening Bay in Port Nelson. Here the *Mermaid* was hauled on shore for repairs to her keel and stern post and Cunningham was free to explore the Kimberley flora at leisure.

At Careening Bay Cunningham collected 54 species, the largest number for any site on the Kimberley coast. Among his collections was the 'gouty *Capparis*', which received a longer than normal entry in his specimen list (Cunningham 1821), a list which was subsequently sent to Banks at Soho Square and to William Aiton at Kew. The following was written in January 1821, on the expedition's return to Sydney, as Cunningham prepared a 'fair copy' of his specimen list for Banks and Aiton:

308. *Capparideae*. The young leaves of a Tree of very extraordinary appearance, exhibiting a Trunk 12–20 feet high of a soft spongy nature, 5–9 feet diameter, from which proceed subsucculent branches for the most part naked in the months of Aug<sup>t</sup> & Sept., bearing large one-locular pedicell'd fruits which, with its internal character of a dry corky pulp enveloping the seeds, has induced me to consider it a *Capparis*, and, its specific title, *gibbosa*, has suggested itself from its gouty swollen stems. Its young compound leaves (latterly observed) may however lead me to *Crataeva*. What is *Stephania* Willd., see Jacqu., *schoenbr. t. 111*? This singular tree was first observed by me in Sept 1819, on the Shores of Cambridge Gulf in Lat. 15° & Long. 128° 30' and has been traced thro' all the intermediate trendings on this interesting arid coast, so far to the West<sup>d</sup> as Brunswick Bay in 124.45 on the same parallel, from which HM's Cutter took her departure, at the breaking up of the Monsoon, for Port Jackson in October last (1820). It expands its flowers most probably when fully in expanded leaves, in December to February & March during the Rains.

The surviving copy of this list, it is interesting to note, is annotated 'Mr Aiton requests that this list may be returned'. It seems that Banks'/Brown's copy was misplaced, Aiton's copy was borrowed, and not returned! The species is not mentioned during the fourth survey voyage in *Bathurst* in 1821.

At a subsequent date Cunningham clearly realised that his *Capparis* bore a striking resemblance to *Adansonia* from Africa, and spent some time researching the latter. Among his papers held at the Natural History Museum is a draft comparing *Adansonia* and *Capparis gibbosa* (Cunningham undated). The paper has comments on the two taxa set out side by side (presented sequentially below for ease of reading). Two points are worth noting from this draft paper: firstly, Cunningham clearly recognised the similarities between *Adansonia* and his *Capparis* (although not going so far as to suggest that his plant belonged in *Adansonia*), and secondly, he fully adopted the manuscript name *Capparis gibbosa* for his discovery, clearly expecting it be published. His draft paper is transcribed below.

*A comparative view of Adansonia of southern Africa and Capparis gibbosa of the North West Coast of Terra Australis, both trees of singular habit.*

#### *Adansonia*

*Cal. 1-phyllus, 5-fidus deciduis. Cor. 5-petala. stamina numerosa filamenta intervassiicoalita. Antherae reniformis incumbentes. Stylus longissimus tubulosus. Stigmata plura, decemradiata prismatica. Caps. oblonga lignosa, 10-locularis, pulpa farinacea polysperma.*

#### *General Remarks*

*The Trunk is not above 12–15 feet high, but from 65 to 78 feet round. The lower branches extend horizontally, and as they are about 60 feet in length, their own weight bends their extremities to the ground, and thus form an hemisphaerical mass of verdure 120 or 130 feet diameter.*

*The Roots extend as far as the branches, that is the middle forms a Pivot, which penetrates a great way into the earth, the rest spread near the surface. The flowers are in proportion to the size of the Tree, and are follow'd by an oblong fruit, pointed at both ends, about ten inches long, 5 or 6 broad and coated with a Kind of greenish down, under which is a ligneous rind, hard and almost black, mark'd with rays, which divide it lengthwise into sides. The fruit hangs to the Tree by a Pedicle two feet long, and an Inch diameter. It contains a whitish spongy juicy substance, with seeds of a brown colour, and shaped like a Kidney-bean. The Bark of this Tree is nearly an Inch thick, of an ash-colour'd Grey, greasy to the touch, bright and very smooth; the outside is cover'd with a kind of Varnish, and the inside is green speckled with red. The wood is white and very soft, the first shoots being green and downy.*

*The leaves of the young Plants are entire of an oblong form, about four or five inches long, and almost three broad towards the top, having sev<sup>l</sup> veins running from the middle rib: they are of a lucid green colour. As the Plants advance in height, the leaves alter, becoming divided into three parts, and afterwards into five lobes, which spread out into the shape of a Hand.*

*The Tree sheds its leaves in November, and new ones begin to appear in June. It flowers in July and the fruit ripens in October and November.*

*The Age of the Tree is perhaps no less remarkable than its enormous size. M. Adanson relates that in a Botanical excursion to the Magdalene Islands in the neighbourhood of Goree, he discover'd*

some African Calabashes, from 5 to 6 feet diameter, on the bark of which were engraved or cut to a considerable Depth, a number of European Names. Two of these Names, which he was at the trouble to repair, were dated, one in the 14<sup>th</sup> and the other in the 15<sup>th</sup> Century. The letters were about 6 inches long, but in breadth they occupied a very small part only of the circumference of the Trunk, from whence he concluded they had not been cut when these Trees were young.

These Inscriptions however he thinks sufficient to determine pretty nearly the Age, which the *Adansonia* may attain, for even supposing that those in question were cut in their early years, and that Trees grew to the Diameter of six feet in two centuries, as the engraved letters evince, how many Centuries must be requisite to give them a Diameter of 25 feet, which is perhaps not the last term of their growth. The inscribed Trees mention'd by M. Adanson to have been seen by him in 1749, were observed two centuries before by Thévet; viz in 1555 [sic, Thévet, 1557], who speaks of them in the relation of his Voyage to Terra antarctica, or australis.

### *Capparis*

Cal., Cor. Flores nondum vidi

Caps. (v. Bacca) elliptica corticosa pedicellata unilocularis polysperma. Semina in medulla, v. pulpa sicca suberosa nidulantia.

### General Remarks

The particular line of Coast of Terra Australis where this remarkable Tree seems alone to be indigenous having never been visited at the Season wherein it produces its blossom, its floral fructification is wholly unknown; all therefore that is presumed of its natural Class and family has been gather'd from the structure of its well ripen'd fruit, with which the Trees have (during the periods of the surveys of the N.W. Coast) been abundantly laden.

The Trunk of this Tree has been observed 12 to 20 feet in height, and from 15 to 27 feet in circumference, of a subcylindrical form, very slightly conical, or rounded with a somewhat less Diameter at its extreme elevation than at its base. From the summit proceed strong arms, or main branches, which extend about 35 or 40 feet; in some, truly horizontal, whilst in others their inclination is in an irregular manner upwards; and the Roots (from the circumstance of the Tree being uniformly found growing in very shallow soil, and frequently among Rocks) scarcely even penetrate far beneath the surface, but rather spread themselves upon it. The fruit which has been always observed at the extremities of the branches is a capsule of an oval figure 5–8 inches long, rounded at the apex, having a hard woody brittle shell, cover'd with a greyish brown villous coat.

The fruit is inserted on the branch by a pedicle 2–3 inches long, and within its solitary cell is a whitish corky dry substance with which many reniform seeds are enveloped. The Cortex or outer Bark is about an Inch thick, of an ash-colour'd Grey, and of a glossy smooth appearance; the liber being of a brownish red colour. The wood is white of a coarse fibre, extremely soft, spongy and full of sap; so much so, that without difficulty a Sharp Instrument can be altogether thrust into it. The extremities of the branches which were bursting forth into leaf in September and October, are green and translucent, and very tomentose, the leaves themselves being of quinary insertion on a common Petiole.

This remarkable *Capparis* seems to cast its leaves in the middle of the dry season (June or July)

*and the new ones make their appearance (as before stated) at the close of September, or beginning of October. It probably produces its flowers in the Rains (December to February) and we have gather'd its ripen'd Capsules in September and October. With respect to the rapid or tardy progress of the growth, or the subsequent duration of this remarkable Capparis which forms a feature in the Landscape of those portions of the Coast whereon it is found, it is impossible to form any just or correct Idea; since no facts of a defined series of stages of growth in the Tree were detected, nor were the observations made during the voyages sufficient to fix a Datum from which even a presumed Calculation could be made of the period required to allow the Tree to attain the enormous dimensions above stated. Altho' no wrecks of Old decay'd Trees were remark'd on those parts of the Coast where the species is most abundant, it is nevertheless possible that so far from its ever arriving at the extraordinary age allow'd Adansonia, it makes a more rapid advancement to maturity, and may really be of proportionate temporary Duration, an opinion grounded wholly on the acknowledged quick growth of Bombax Ceiba, a Tree of Equinoctial America, which arrives by the aid of Humidity, shade and warmth of Atmosphere, at considerable Dimensions in a few Years, approaching those of Capparis, to which also it is analogous in the deciduous Char' of its compound leaves, the softness of its wood and the texture of its fibre.*

*The Capparis was first seen on the shores of Cambridge Gulf in Lat. 15° So. and Long. 128° 30' East, and it was traced on the North West Coast in the above parallel, so far to the Westward as 124° 25' E. in Brunswick Bay on the same extensive Shores.*

*The name of His Majesty's Cutter was deeply carved upon the stem of the largest Tree on the shores of Careening Bay, Port Nelson, with certain Initials and the Date of the Year of our Visitation.*

A.C.

The above paper is typical of much of Cunningham's writing: it is thoroughly researched and logically written, almost to the point of pedantry. So why was it not published?

The paper is undated, but must have been written during Cunningham's residence at Strand-on-the-Green between 1831 and 1836. He probably had access to fresh material of the African *Adansonia*, presumably from specimens growing at Kew, as he was able to describe its development and colour when fresh. He also had access to literature which would not have been available in Sydney. It is known that during this period he met frequently with Robert Brown to discuss the taxonomy of various Australian plants (Orchard & Orchard 2015), and it seems inconceivable that the subject of such an unusual plant would not have come up in these discussions. Further, this draft paper is bound with other Cunningham manuscripts in the three volume compendium housed in the Botany Library, Natural History Museum. Other items in this compendium are seed, plant, bulb and specimen lists, copies of parts of Cunningham's journal, and letters to Banks (and a couple to Aiton), i.e. correspondence and documents sent to Banks, inherited from him by Brown and deposited in the British Museum. It seems very likely then that Cunningham wrote this draft paper and gave it to Brown for consideration and advice during the period 1831–1836. When Cunningham was unexpectedly recalled to Sydney in 1836 (where he died in 1839), the paper was forgotten, and later gathered up for binding with other Cunninghamiana.

Cunningham wrote a ground-breaking plant geography essay on the plants discovered during the King surveys, and this was published as an Appendix to King's *Narrative* (Cunningham 1827). In this Appendix (p. 25) he devoted half of his description of Capparides to his 'gouty-stemmed *Capparis*', but unfortunately did not mention the species epithet he had coined for it. Had he done so the name would have been validly published there.

When Robert Heward came to write Cunningham's biography/obituary (Heward 1842) he had access only to Cunningham's journals and some letters. However in the case of the Boab he was able to quote a substantial description from the journal, based on a collection made by Cunningham at Careening Bay: '...the arborescent gouty species of this genus, (*Capparis gibbosa*, A.Cunn.,) which was first observed on the shores of Cambridge Gulf, is frequent here, growing to an enormous size, and laden with large fruit. I measured the stem of one very remarkable tree of this species, and found it near twenty-eight feet in circumference, and scarcely twenty-five feet high. Some of the trees were in the earlier stages of veneration, the extremities of the naked branches appearing green, and one that I opened exhibited the character of *folia quintia*.'

In 1857 Ferdinand Mueller described *Adansonia gregorii*, based on his own specimens collected 'In planitiebus orariis et ripariis ad flumina Victoria et Fitzmaurice, ad promontorium Point Pearce alibique.' It is noteworthy that in the final paragraph of this description he cited 'Gouty-stem Tree, *All. Cunn. in King's Survey, App. p. 25*.' Mueller must have recognised it from the description, as he had no access to Cunningham specimens (or perhaps Hooker inserted the cross-reference in editing Mueller's paper). Neither had access to Cunningham's journal, specimen list, or draft paper, in all of which his manuscript name existed – these documents were all in the British Museum with Brown, and the only specimen was also in BM, in the set sent to Banks/Brown. So Mueller can be excused for not taking up Cunningham's epithet (he was unaware of it unless he had read Heward's biography). But in describing the species again he inadvertently created a taxonomic synonym.

In 1986 Gordon Guymer recognised the conspecificity of the two names and annotated the type specimen in BM as '*Adansonia gibbosa* (Cunn.) Guymer' but did not publish the combination. Nine years later Baum (1995) took up Guymer's combination as *Adansonia gibbosa* (A.Cunn.) Guymer ex Baum as part of a revision of *Adansonia*. This combination was subsequently adopted by a small number of authors (see Wilson and Guymer (1999) for a summary of some of them). Almost immediately Macfarlane and Guymer (1995) indicated that a proposal to conserve the name *A. gregorii* would be prepared, and such a proposal (to reject the name *Capparis gibbosa*) was published by Wilson and Guymer (1999). See also Kenneally (undated, c. 1996).

The proposal to reject the name *Capparis gibbosa* was based on two arguments: first, that the publication of the name by Heward was actually or potentially invalid (i.e. he did not intend to publish a new name, the descriptive matter was inadequate), and second, the new combination *A. gibbosa* displaced the name *A. gregorii*, long used for an important and distinctive Australian tree.

The Spermatophyta Committee considered the proposal and voted 9:6 in favour of rejection, the bare 60% required to accept (Brummitt 2004). This decision was subsequently endorsed by the General Committee and the IBC.

The decision of the Spermatophyta Committee was based on the evidence presented by Wilson and Guymer (1999). The committee did not have access to Cunningham's journal, or his unpublished paper, and did not mention Cunningham's description (unnamed) of the species in King's *Narrative*. It is interesting to speculate whether their decision would have been different had they been aware of this material. After all, a change of mind by just one of the Committee would have seen rejection of the proposal.

It was claimed by the Spermatophyta Committee that Heward did not intend to validate this species name, yet he supplied the name and author, a description, and collection location for the type specimen (a specimen which still exists in BM). Later in the same biography Heward described from Cunningham's

notes four taxa that are generally considered to be validly published: *Crinum norfolkianum* A.Cunn. ex Heward, *Hymenanthera oblongifolia* A.Cunn. ex Heward, *Lomaria norfolkiana* Heward and *Nephrodium remotum* Heward. The description of *Urtica gigas* A.Cunn. ex Heward in the same paper exactly parallels that of *Capparis gibbosa*, in that it is part of his journal commentary, in English, not in Latin, and is quite brief. Despite this it is usually accepted as validly published. Elsewhere, in letters to William Hooker and William Colenso, Heward said that he intended to publish or have published Cunningham names that were not in print at that time. For example, in a letter to Colenso just after Cunningham's death, and speaking of species collected in New Zealand by Cunningham in 1838, he said 'I have written a sketch of the labours of our late friend which if you will inform me how I can forward to you shall be transmitted. I shall also describe the new plants found by Cunningham in his visit of 1838, which shall be forwarded at the same time.' (Orchard & Orchard 2015: letter 6/o/1). To Hooker, Heward wrote in 1840: 'I have packed up a set of poor Allan Cunningham's last collection of ferns... Among the ferns there is I believe only three new species, viz. a *Gleichenia* which I have named after him, a *Davallia* and a *Dicksonia*.' (Orchard & Orchard 2015: letter 7/l/5). The *Gleichenia* was published as *Gleichenia cunninghamii* Heward in Hooker (1846). Bentham later published at least one name supplied by Heward based at least in part on Cunningham specimens: *Atriplex vesicaria* Heward ex Benth. There is thus little doubt that Heward intended that Cunningham's unpublished names should be committed to print, either by himself, or through him, by others.

The Code is clear that in making decisions on nomenclatural matters only actions actually made and intentions stated in print are to be considered; unstated intentions cannot be reliably invoked. Heward fulfilled all the requirements for valid publication, the only doubt being on his 'intentions'. It is generally agreed that he did validly publish other Cunningham names in the work in question, thus demonstrating his intention that they be formally recognised. Some descriptions were better and more adequate than others, but if all other conditions for valid publication were fulfilled (and they were for *Capparis gibbosa*) then I argue that all were validly published. How did Heward's actions differ from those of, for example, William Hooker, who frequently validly published names for new taxa by quoting from letters or journals received from abroad? Did Cunningham intend this extract from his journal to be a validating action? He couldn't – he was dead. However his previous actions, described above, show that he believed he had a new species, had gone to considerable trouble to describe and characterise it, had consistently used the name *Capparis gibbosa* for it, and had gone within a whisker of formally publishing it himself. So it can hardly be argued that Cunningham did not wish to see the plant formally described. If he had sent his draft paper to Hooker rather than (as suggested above) giving it to Brown, his name would almost certainly have been formally published in one of Hooker's journals (see Orchard (2013), for an account of Cunningham's publication collaboration with Hooker).

This leaves the argument that adoption of the name *A. gibbosa* would displace a long-used and familiar name, *A. gregorii*, applied to a tree of economic, cultural and iconic importance. There is certainly considerable merit to this argument, but, in view of the close vote, it is questionable whether it would have been sufficient to carry the day with a committee composed largely of botanists from the northern hemisphere.

Nevertheless, the vote was carried and there seems little point in resurrecting the argument in a formal sense. *Adansonia gregorii* remains a well-known and long-used name for a very familiar and locally characteristic tree, and little but confusion would be gained by changing it now for purely nomenclatural reasons. It is too late to retrieve for Cunningham the nomenclatural credit that he deserved for his discovery and investigation of the species, but this paper will put on record his achievements in this respect.

### Concluding remarks

There are a few postscripts necessary to this tale. In his draft paper Cunningham doubted whether his *Capparis gibbosa* would be found to be as long lived as *Adansonia*, believing that it might be found to be, like *Bombax*, fast growing but of relatively short duration. In this he was wrong, and it is now clear that *A. gregorii*, like its African relatives, is very long lived. Cunningham mentioned in his draft paper that the largest tree at Careening Bay had been inscribed with the name and date of *Mermaid's* visit. This tree still stands, in perfect health, 200 years later (Figure 2). Cunningham said that the largest tree at Careening Bay measured 28 feet in circumference (about 7 feet or over 2 m in diameter). Today the tree has split into two trunks, each about this size or a little larger. If the tree was already the largest 200 years ago, it is not unreasonable to assume a present age of over 400 years, probably much more, for this tree. Cunningham also believed that his plant, unlike African *Adansonia*, lacked a taproot, and had only surface roots. This is not so. Bowman (1997) has shown that *A. gregorii* has a well-developed taproot, from which it can resprout after fire. Finally: a disclosure. The author was a member of the Spermatophyta Committee that made the decision on *Adansonia* in the 1990s, but, like the other members of the committee, was unaware of the manuscript material transcribed above. It is a pity that this was so, and that a more informed decision could not have been made, but it is now too late to go back. The species should continue to be known as *A. gregorii*.



Figure 2. The Mermaid Tree (*Adansonia gregorii*). Photograph by T.A. Orchard taken at Careening Bay, 1 April 2016.

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## An examination of the Australian genus *Xerochrysum* (Asteraceae: Gnaphalieae)

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### Abstract

Wilson, P.G. An examination of the Australian genus *Xerochrysum* (Asteraceae: Gnaphalieae). *Nuytsia* 28: 11–38 (2017). In this partial revision of *Xerochrysum* Tzvelev the following taxa are described as new: *X. alpinum* Paul G. Wilson, *X. boreale* Paul G. Wilson, *X. halmaturorum* Paul G. Wilson and *X. interiore* Paul G. Wilson. Accounts of several published and unpublished species from north-east New South Wales and south-east Queensland that are currently recognised are omitted since these are being studied by other botanists; however, these taxa are included in the key to species provided here. Lectotypes are chosen for *Helichrysum bracteatum* var. *viscosum* DC., *X. bicolor* (Lindl.) R.J. Bayer and *X. viscosum* (Sieber ex Spreng.) R.J. Bayer.

### Introduction

The discrimination and naming of *Xerochrysum* Tzvelev was established in 1990. Tzvelev recognised that the Australian plant commonly referred to *Helichrysum bracteatum* (Vent.) Haw., which had long been cultivated in Russia, belonged to a distinct genus. However, partly due to the title of Tzvelev's paper (which indicated that it dealt with Russian species of Asteraceae) and the language in which it was written (Russian), the article was largely overlooked. This led Anderberg and Haegi (Anderberg 1991) to describe as new the genus *Bracteantha* Anderb. & Haegi based on the same type, *Xeranthemum bracteatum* Vent. Subsequently, when this synonymy came to be recognised, Bayer (2001) transferred to *Xerochrysum* those species that had been published under *Bracteantha*.

Recent studies by Schmidt-Lebuhn *et al.* (2015) support the recognition of *Xerochrysum* as circumscribed by Bayer and as delineated in this paper, while leaving open the relationship of somewhat ill-defined genera such as *Coronidium* Paul G. Wilson and *Leucochrysum* (DC.) Paul G. Wilson that have been associated with it.

The genus has been considered to consist largely of one polymorphic species, *Xerochrysum bracteatum* (Vent.) Tzvelev, which, in the broad sense, occurs over much of Australia. However, this view is based on the study of herbarium material; botanists familiar with the plants in the field have come to a different conclusion and it is their opinion on appropriate rank that has been followed in this paper.

Some of the taxa in the *X. bracteatum* group that occur in north-eastern New South Wales and south-eastern Queensland have been excluded from this treatment since they are currently under examination

by Ian Telford and Jeremy Bruhl of the University of New England; however, these taxa are included in the key to species below.

### Taxonomy

**Xerochrysum** Tzvelev, *Novosti Sist. Vyssh. Rast.* 27: 151 (1990). *Type: Xerochrysum bracteatum* (Vent.) Tzvelev.

*Bracteantha* Anderb. & Haegi, *Opera Bot.* 104: 102 (1991), *nom. illeg.* *Type: Bracteantha bracteata* (Vent.) Anderb. & Haegi.

Annual or perennial *herbs*, sometimes rhizomatous. *Indumentum* arachnoid, scabrous, or glandular. *Leaves* alternate; lamina flat or with margin recurved. *Capitula* terminating branches or branchlets, homo- or hetero-gamous, disciform. *Involucral bracts* multiseriate; lamina rigidly chartaceous, often spreading at junction with claw when mature; *claw* coriaceous, broadly oblong, flat; stereome broad, that of inner bracts fenestrate, veins numerous, anastomosing and ending near apex of claw, or vein solitary and extending into lamina. *Receptacle* ± flat, epaleate. *Outermost florets* usually sterile or sometimes female; *corolla* very narrowly tubular, shortly 4-lobed. *Inner* (or all) *florets* bisexual; *corolla* narrowly tubular, *lobes* ovate; *anthers* with apical appendage ovate and outwardly concave, *tails* slender, ± equal to collar; *style arms* slender, with rounded to narrowly acuminate appendage. *Achene* cylindrical or obloid, 2.5–3.5 mm long; *pericarp* thick, collenchymatous, smooth, glabrous, 2-veined, surface with linear idioblasts *c.* 0.1–0.2 mm long paired in parallel or these absent; *stipe* hollow, basal margin of one row of thickened cells; *apex* patelliform when mature. *Testa* free from pericarp, brown, cells ± equilateral, without thickening; vein passing to apex. *Pappus* uniseriate; bristles slender, equal to or exceeding corolla, colourless or yellow, consistent with the colour of the medial involucral bracts, barbellate with apical cells acute, bristles very shortly united at base and eventually deciduous as a whole or in pieces, sometimes persistent.

*Etymology.* The derivation of the name *Xerochrysum* was not indicated by Tzvelev (1990), however it evidently comes from the Latinised Greek words *xeros* (dry) and *chrysos* (gold), presumably with reference to the laminae of the involucral bracts. The name is probably also linked to the names *Xeranthemum* L. and *Helichrysum* Mill., in which genera the type species has in the past been included by some authors.

*Indumentum.* Cottony or woolly hairs are found on the stems and leaves of most species of *Xerochrysum*. These hairs each have a short multicellular base that may persist after the cottony apex has been shed and which may then become hard so as to form a scabrous surface to the stem or leaf. In some species sessile, globular, unicellular hairs are found and these are usually viscid.

*Involucral bracts.* Anderberg and Haegi (Anderberg 1991), in their description of the genus *Bracteantha*, indicated that the involucral bracts of the included species had an undivided stereome; this is correct for the outer and intermediate bracts but not for the inner ones in which the stereome is divided and fenestrate. The claws of all bracts have a branched venation.

*Notes.* In this paper *Xerochrysum* is divided into two groups that differ in the venation of their medial involucral bracts, the *X. bracteatum* group having a multi-veined claw and the *X. milliganii* (Hook.f.) Paul G. Wilson group having a 1-veined claw, with the single vein continuing into the lamina. The former group encompasses about a dozen taxa that have been loosely treated as conspecific under

*Helichrysum bracteatum* s. lat., and is distributed over most of Australia. The *X. milliganii* group consists of five Tasmanian taxa, some of which extend into south-eastern Australia.

Bayer *et al.* (2002), in a paper on the chloroplast DNA sequences in Australian Gnaphalieae, suggested that *Helichrysum leucopsideum* DC. is sister to a clade comprising *X. bracteatum*, *Triptilodiscus pygmaeus* Turcz., *Pogonolepis stricta* Steetz, *Helipterum craspedioides* W.Fitzg. (syn. *Myriocephalus morrisonianus* Diels) and *Hyalochlamys globifera* A. Gray. On the other hand *X. viscosum* (DC.) R.J. Bayer is in a clade that includes *Anemocarpa podolepidium* (F.Muell.) Paul G. Wilson and *Leucochrysum stipitatum* (F.Muell.) Paul G. Wilson. The conclusions of Schmidt-Lebuhn *et al.* (2015), based on nuclear as well as chloroplast sequences, are in many ways contrary to those of Bayer *et al.* (2002), and suggest that *H. leucopsideum* is generically distinct from *Xerochrysum* while *X. bracteatum* and *X. viscosum* are closely related. The latter classification is supported both by the morphology and the apparent hybridisation of *X. bracteatum* with *X. viscosum*.

### Key to species

1. Herbs, sometimes rhizomatous; claw of medial involucre bracts with several veins that terminate at its apex
2. Stem and leaves viscous, glabrous or sparsely hispidulous; leaves filiform to linear with revolute margins ..... **8. *X. viscosum***
- 2: Stem and leaves cottony or woolly, glandular-puberulous or hispidulous, if glabrous then not prominently viscous; leaves linear to elliptic or obovate, flat or with recurved margins
3. Leaves woolly; lamina of outer 2 or 3 rows of involucre bracts yellow or yellowish brown, rounded, apiculate..... ***X.* sp. ‘Cockatoo Creek’**
- 3: Leaves cottony; lamina of outer bracts variable
4. Leaves linear to linear-elliptic, 10–30 cm long; medial involucre bracts obtuse..... ***X.* sp. ‘Moreton Bay’**
- 4: Leaves linear to elliptic or obovate, 2–10(–20) cm long; medial involucre bracts acute to acuminate
5. Foliaceous bracts subtending capitula prominent
6. Style appendages narrowly acuminate to triangular, broadly triangular or rounded ..... **1. *X. bracteatum***
- 6: Style appendages rounded to broadly ovate
7. Leaves usually linear to linear-elliptic, rarely ovate or obovate; style appendages rounded to narrowly or broadly ovate; lamina of involucre bracts white or pale fawn ..... **7. *X. papillosum***
- 7: Leaves elliptic to obovate; style appendages broadly ovate; lamina of involucre bracts yellow ..... **5. *X. bicolor***
- 5: Foliaceous bracts subtending capitula absent or inconspicuous
8. Stem minutely cottony towards apex..... **3. *X. boreale***
- 8: Stem cottony or scabrous
9. Leaves elliptic to obovate; capitula yellow
10. Stem prominently bristly beneath capitulum; leaves prominently auriculate at base..... **2. *X. halmaturorum***

- 10: Stem minutely scabrous beneath capitulum; leaves not or scarcely auriculate at base..... **4. X. interiore**
- 9: Leaves narrowly elliptic to narrowly obovate; capitula white or yellow
- 11: Capitula white; stem with cottony hairs below capitulum..... **6. X. macranthum**
- 11: Capitula yellow; stem with or without cottony hairs below capitulum
- 12: Stem without cottony hairs below capitulum..... **5. X. bicolor**
- 12: Stem with cottony hairs below capitulum..... **6. X. macranthum**
- 1: Herbs, rhizomatous; claw of medial involucre bracts with a central vein that passes into the lamina
- 13: Lamina of involucre bracts white, pale pink or crimson
- 14: Stem densely white-cottony; leaves densely cottony on margin, otherwise glabrous or sparsely glandular puberulous..... **9. X. milliganii**
- 14: Stem glandular-puberulous and very sparsely cottony; leaves sparsely cottony on margin, otherwise minutely glandular..... **10. X. collierianum**
- 13: Lamina of involucre bracts yellow
- 15: Stem densely cottony towards apex
- 16: Leaves glabrous or with cottony hairs on margin; involucre bracts smooth ..... **11. X. palustre**
- 16: Leaves sparsely to moderately cottony; involucre bracts minutely scabridulous abaxially..... **12. X. subundulatum**
- 15: Stem glandular-puberulous especially towards apex ..... **13. X. alpinum**

**1. Xerochrysum bracteatum** (Vent.) Tzvelev, *Novosti Sist. Vyssh. Rast.* 27: 151 (1990). *Xeranthemum bracteatum* Vent., *Jard. Malmaison* 1: 2, t. 2 (1803). *Helichrysum bracteatum* (Vent.) Haw. in Andrews, *Bot. Repos.* 6: ad t. 428 (1805). *Helichrysum lucidum* Henckel, *Adumbr. Pl. Hort. Hal.* 5 (1806), *nom. illeg.* *Helichrysum chrysanthum* Pers., *Syn. Pl.* 2: 414 (1807), *nom. illeg.* (*Xeranthemum bracteatum* cited in synonymy). *Helichrysum bracteatum* (Vent.) Willd., *Enum. Pl.* 869 (1809). *Helichrysum bracteatum* var. *chrysanthum* DC., *Prodr.* 6: 189 (1838), *nom. illeg.* (based on type of *X. bracteatum*). *Xeranthemum lucidum* Maund, *Bot. Gard.* ed. 3, 1: 156 (1878), *nom. illeg.* *Bracteantha bracteata* (Vent.) Anderb. & Haegi, *Opera Bot.* 104: 102 (1991). *Gnaphalium chrysanthum* Sch.Bip., *Bot. Zeitung* 3: 171 (1845). *Helichrysum lucidum* var. *normalis* F.Muell., *Fragm.* 11: 48 (1878), *nom. inval.* *Helichrysum bracteatum* var. *normalis* Domin, *Biblio. Bot.* 89: 668 (1929), *nom. inval.* *Type citation:* ‘originaire de la Nouvelle Hollande’, cultivated at La Malmaison (*holo:* G 00341478 image!).

*Helichrysum banksii* A.Cunn. ex DC., *Prodr.* 6: 188 (1838). *Type citation:* ‘in Novae-Holl. ora boreali-orient. ad flum. Endeavour in sylvaticis graminosis olim legit cl. Banks et postea A Cunningham jul. flor. (v.s. comm. a cl. A. Cunn.)’ (*holo:* G-DC, G 00328465 image! ‘Grassy forest-land, Endeavour River, Qld, July 1819, A. Cunningham’).

?*Helichrysum bracteatum* var. *eripodum* DC., *Prodr.* 6: 189 (1838). *Type citation:* ‘Specim. spontanea nec hortensia.’ (*holo:* G-DC G 00470435 image! ‘Nouvelle Hollande côte orient. Museum de Paris. 1821’).

Erect, branched or unbranched, often viscid, annual or perennial *herb* to 60 cm high. *Stems* and *branches* finely sulcate, with arachnoid hairs, and usually with sessile and stipitate glandular hairs.

*Leaves* usually cauline (rarely radical), chartaceous, oblong-elliptic, to 7 cm long, obtuse to acute or acuminate, sparsely to densely cottony, usually with sessile and stipitate glandular hairs, rarely glabrous. *Capitula* solitary or in loose cymes, terminating short or slender peduncles, closely subtended by c. 3 narrowly oblong-acuminate foliaceous bracts, these sometimes inconspicuous. *Involucre* 3–6 cm diam., yellow or white with the outer bracts tinged brown; outer and medial bracts rounded or obtuse, the claw multi-veined; inner bracts acute to acuminate, minutely serrulate, smooth. *Style appendages* narrowly acuminate to broadly triangular or rounded. *Achene* cylindrical, 2.5–3.0 mm long, smooth; idioblasts narrowly linear, 0.1–0.2 mm long. *Pappus* caducous as a whole, sometimes tardily so. (Figure 1)

*Selected specimens examined.* QUEENSLAND: Kingaroy, 16 Apr. 1947, *L.S. Smith* 3055 (BRI); between Springsure and Rolleston, 22 Nov. 1978, *T. Stanley & E. Ross* 78466 (BRI). NEW SOUTH WALES: Port Macquarie, Feb. 1897, *E.R. Brown s.n.* (NSW); 5.5 km S of South Guyra, 2 Apr. 1975, *T.A. Halliday* 337 (HO); Breakneck Lookout, S of Taree, 5 Jan. 1964, *H. Salasoo* 2863 (NSW); Mt Lindsay to Kangaloon, 3 Apr. 1957, *C.L. Wilson* 560 (NSW). VICTORIA: Grampians National Park, 31 Dec. 1988, *R.M. King* 9726 (MEL); Gunbar Island, 5 July 1953, *R. Melville* 3894 & *J. Chinner* (HO); Hattah Lakes National Park, 22 Jan. 1970, *T.B. Muir s.n.* (MEL); 8 km NNW of Genoa, 24 Oct. 1991, *N.G. Walsh* 3246 (MEL). SOUTH AUSTRALIA: Chowilla Stn, 7 Jan. 1989, *C. O'Malley* 1391 (AD); 8 km W of Coomandook, 31 Oct. 1961, *C.R. Sharrad* 1238 (AD); Hypurna HS, 12 Sep. 1980, *H.R. Toelken* 6637 (AD).

*Distribution.* Found in eastern Queensland, eastern New South Wales, Victoria and eastern South Australia.

*Chromosome number.*  $n = 12$  (Watanabe *et al.* 1999: 783), based on the voucher *M. Ito* 96026 from Polblue Swamp, c. 31°56' S, 151°24' E, New South Wales.

*Notes.* The name *Xeranthemum bracteatum* was based on a cultivated plant that originated in Australia and it is assumed that the seed was collected from near Sydney.

*Xerochrysum bracteatum* is typically an erect, branching, short-lived perennial; however, in coastal situations it may be stunted, with most leaves forming a basal rosette. It is treated here in a moderately broad sense and includes a number of variants that could be recognised as distinct taxa. This course has not been taken, partly because of its variability which would entail field work to satisfactorily resolve.

As circumscribed here, *X. bracteatum* grades into *X. papillosum*, *X. interiore* and *X. boreale*, but can usually be distinguished as indicated in the key. It is also similar to *X. bicolor*, *X. macranthum* and *X. papillosum*; from these species it differs in the shape of the style appendages and from the last two usually in the colour of the involucre bracts.

For comments on the apparent merging with *X. viscosum* see under that species.

## 2. *Xerochrysum halmaturorum* Paul G. Wilson, *sp. nov.*

*Type:* Cape St Albans, Kangaroo Island, South Australia, 24 November 1994, *B.M. Overton* 2513 (*holo:* AD 99610190; *iso:* MEL 2048046).

Perennial, branched *herb* to 1 m high. *Stems* prominently bristly with stiff multicellular trichomes. *Leaves* scattered, somewhat congested towards the base of the plant, elliptic to obovate, sessile or



Figure 1. *Xerochrysum bracteatum* (R. Melville 3894, HO 27069).

narrowed to a broad petiole, auriculate and somewhat stem-clasping at base, in all to 9 cm long, to 3 cm wide, obtuse, apiculate, scabrous above, prominently gland-dotted below, margin with bristly hairs. *Capitula* solitary, terminal to branches. *Involucre* to 5 cm diam., bright yellow; outer bracts pale reddish brown, rounded to obtuse; medial bracts obtuse to acute, the claw multi-veined. *Style appendages* ovate. *Achene* smooth; idioblasts numerous, narrowly linear, c. 0.2 mm long. *Pappus* deciduous. (Figure 2)

*Selected specimens examined.* SOUTH AUSTRALIA: Encounter Bay, W of Bluff, 20 Jan. 1933, *J.B. Cleland s.n.* (AD); Second Valley Forest Reserve, 6 Dec. 1938, *J.B. Cleland s.n.* (AD); Inman Valley, *J.B. Cleland s.n.* (AD); section 138, Hundred of Cassini, near Mt McConnell, 8 Apr. 1987, *T. Croft* 11 (AD); Hindmarsh Valley Reservoir, Oct. 1909, *E.H. Ising s.n.* (AD); Cape Hart National Park, 13 Nov. 1983, *G. Jackson* 1633 (AD, HO); 5.7 km SW of Cape Willoughby Lighthouse, 18 Nov. 1989, *B. Overton, P. Canty & S. Kinnear* NPK1 40881 (AD) Torrens Gorge, 10 Nov. 1879, *R. Tate s.n.* (AD).

*Distribution and habitat.* Found on Kangaroo Island and on the adjacent South Australian mainland in the southern Fleurieu Peninsula. Grows in coastal or near-coastal situations on coastal cliffs, sides of gullies, and in eucalypt forest, usually over basalt or limestone.

The only herbarium specimens of *X. halmaturorum*, in the strict sense, that came from the South Australian mainland were collected over 70 years ago, suggesting that it is now either rare or no longer present on the Fleurieu Peninsula. All recent collections from this area show intergradation with *X. bracteatum*.

*Etymology.* The epithet *halmaturorum* has been applied by several botanists to plants that occur on Kangaroo Island. It is derived from the Greek word *halma* to leap, which alludes to the kangaroo, and the genitive suffix *-orum*.

*Notes.* *Xerochrysum halmaturorum* is similar in morphology to *X. macranthum* from south-west Western Australia and is a link to the typical form of *X. bracteatum* from south-eastern Australia.

### 3. *Xerochrysum boreale* Paul G. Wilson, *sp. nov.*

*Type:* Port Keats opposite Dorchester Island, Northern Territory, 9 August 1983, *C. Dunlop* 6459 & *G. Wightman* (*holo:* CANB 345434; *iso:* AD 98419226, BRI, DNA D0021944, MEL 0291510, NSW 518497, NT).

*Illustration.* J. Brock, *Top End native plants* p. 215 (1988), as *Helichrysum bracteatum*.

Erect perennial, branched *herb* to 50 cm high. *Stems* glandular-hirtellous, usually densely cottony towards apex. *Radical leaves* densely clustered around the base forming a rosette, narrowly elliptic to obovate, to 10 cm long; *cauline leaves* linear to very narrowly oblong, to 10 cm long, acuminate, sparsely cottony and with sessile, globular, glandular hairs predominantly abaxial. *Capitula* solitary on slender, densely cottony peduncles which do not become scabrous, subtended by inconspicuous leafy bracts. *Involucre* usually c. 3 cm diam.; outer bracts pale yellowish brown, medial and inner bracts yellow, the medial ones obtuse and with the claw multi-veined. *Style appendages* narrowly triangular, 0.3–0.5 mm long. *Achene* c. 2.5 mm long; idioblasts numerous, filiform, c. 0.15 mm long. *Pappus* bristles to 7 mm long.



Figure 2. *Xerochrysum halmaturorum* (G. Jackson 1633, HO80731).

*Selected specimens examined.* WESTERNAUSTRALIA [localities withheld for conservation reasons]: 7 Sep. 1921, *C.A. Gardner* 1565 (PERTH); 1901, *F.M. House s.n.* (PERTH); 6 Sep. 1995, *A.A. Mitchell* 648 (MEL). NORTHERN TERRITORY: W of Port Bradshaw, 31 Oct. 1968, *N. Byrnes* 979 (NT); 5 miles [c. 8 km] W of Wangi HS, 28 Aug. 1969, *N. Byrnes* 1680 (NT); Fog Bay, 13 June 1994, *I.D. Cowie* 5115 (CANB); 19 km N of Mirrngadja, Arnhem Land, 5 Nov. 1987, *G. Leach & C. Dunlop* 1550 (NT); Mt Tolmer, 22 Oct. 1972, *J. McKean* B754 (CANB, NT); Mirrngatja [Mirrngadja], Arnhem Land, 9 Aug. 1986, *N.H. Scarlett* 201 (CANB). QUEENSLAND: Cooladdi, 75 km WSW of Charleville, 25 Oct. 1977, *L. Pedley* 4456 (AD).

*Distribution and habitat.* Occurs in the northern Pilbara and Kimberley regions of Western Australia, the far north of the Northern Territory, and the far north of Queensland. Found on loamy, sandy, or gravelly soils in grassland or woodland, sometimes in seasonally inundated areas.

*Conservation status.* To be listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian flora (M. Smith pers. comm.). In Western Australia, this species is known from just five collections and has not been collected in the Kimberley region since the early 1920s.

*Etymology.* The specific epithet is derived from the Latin *borealis* (northern), and refers to the northern Australian distribution of this species.

*Notes.* This species is similar to *X. interiore*. The two species differ principally in leaf shape. However, leaf size and shape vary considerably with habitat and many collections cannot be referred unequivocally to either species based on these characters alone.

#### 4. *Xerochrysum interiore* Paul G. Wilson, *sp. nov.*

*Type:* 4 miles [c. 6.4 km] east of Acacia Well, Undoolya, Northern Territory, 9 November 1954, *G. Chippendale* 450 (*holo:* AD 95805047; *iso:* BRI, CANB 37993, DNA A0000450, NSW 518728, PERTH 00423815).

Annual or perennial, branched *herb* to 50 cm high. *Stem branches* slender, scabrescent and sometimes sparsely cottony towards apex. *Leaves* cauline, the medial ones broadly elliptic, thin, apex rounded to obtuse, apiculate, base narrowed to a broad petiole, in all to 8(–17) cm long, abaxially with minute sessile glands, adaxially almost glabrous. *Capitula* terminating branches; subtending foliaceous bracts of mature capitula inconspicuous. *Involucre* 3–5 cm diam., yellow; outer bracts with rounded apex; medial bracts obtuse with acumen, the claw multi-veined. *Style appendages* narrowly triangular. *Achene* c. 3 mm long, smooth; idioblasts numerous, narrow-linear, 0.1–0.2 mm long. *Pappus* 6–8 mm long, very shortly plumose except at summit, deciduous. (Figure 3)

*Selected specimens examined.* WESTERN AUSTRALIA: 5 mi [8 km] along Warburton Rd off Gunbarrel Hwy, 4 Oct. 1971, *U. Johnson* 16 (NSW, PERTH); about 90 km S of Munjina RH on Newman road, 4 Sep. 1995, *A.A. Mitchell* PRP 648 (PERTH). NORTHERN TERRITORY: Mt Zeil, 13 June 1974, *G.W. Carr* 1587 & *A.C. Beauglehole* 45566 (PERTH); 5 mi [8 km] N of Indiana Stn, 11 Sep. 1956, *M. Lazarides* 5964 (PERTH); Alice Springs, c. 15 km W on Larapinta Drive, 19 Aug. 1998, *C.R. Mitchell & J. Risler* 1795 (NT); Harry Creek, 50 km N of Alice Springs, 18 Nov. 1988, *D.J. Nelson* 2732 (NT). SOUTH AUSTRALIA: 45 km SW of Everard Park HS, 5 June 1972, *G.C. Cornwall* 213 (AD).



Figure 3. *Xerochrysum interiore* (G. Chippendale 450, PERTH 00423815).

*Distribution and habitat.* Found in the Pilbara and Coolgardie regions of Western Australia, and central Australia (including parts of Western Australia, the Northern Territory, and South Australia). Usually grows in red sand in the 'Centre' but elsewhere in a variety of soils. In the Pilbara the plant has been recorded from plains with *Triodia* grasslands or open eucalypt and *Acacia* woodland.

*Conservation status.* This widespread species is not considered to be of conservation concern in Western Australia.

*Chromosome number.*  $n = 14$ , recorded [as *Helichrysum bracteatum*] by Turner (1970: 384), based on the voucher *B.L. Turner* 5251.

*Etymology.* The specific epithet is derived from the Latin *interior*, with reference to the distribution of this species in central Australia.

*Notes.* The three collections examined from the Pilbara region of Western Australia appear to be of an annual plant whereas plants from other areas are obviously perennial.

Under dry conditions this species has leaves that are small (to 8 cm) and obovate, whereas in moist situations the leaves are large (to 17 cm long) and narrowly obovate to obovate. In all cases the style appendages are narrowly or very narrowly triangular.

This species apparently has a higher base chromosome number than either *X. bracteatum* or *X. viscosum*.

**5. *Xerochrysum bicolor*** (Lindl.) R.J. Bayer, *Kew Bull.* 56: 1014 (2001). *Helichrysum bicolor* Lindl., *Bot. Reg.* 21: t. 1814 (1835). *Gnaphalium bicolor* (Lindl.) Sch. Bip., *Bot. Zeitung* 3: 171 (1845). *Helichrysum bracteatum* var. *bicolor* (Lindl.) L.H. Bailey, *Cycl. Amer. Hort.* 2: 723 (1900). *Bracteantha bicolor* (Lindl.) Anderb. & Haegi, *Opera Bot.* 104: 105 (1991). *Type citation*: 'introduced by Mr. Low of the Clapton Nursery.... It is a native of Van Diemen's Land, whence our excellent correspondent Mr. Gunn has sent beautiful specimens (No. 111).' (*lecto*, here designated: *R. Gunn* 111 [*s. dat.*], CGE photo!; possible *isolecto*: MEL 61303, NSW 122366).

Erect perennial *herb* with tuberous roots. *Branches* scabrid with multicelled hairs, cottony hairs absent. *Leaves* narrowly elliptic to obovate, 6–9(–20) cm long, acuminate, chartaceous, sparsely hirsute or scabrid, with minute, sessile, globular, glandular hairs, becoming viscid, scabrous on margin. *Capitula* solitary or terminating branches in an open panicle, subtending foliaceous bracts inconspicuous or linear. *Involucre* hemispherical, to 5 cm diam., laminae smooth, yellow (abaxial surface dusky yellow); outer bracts rounded; medial bracts obtuse, apiculate, the claw multi-veined. *Outer florets* female. *Style appendages* broadly ovate. *Achene* c. 3 mm long, dark brown; idioblasts inconspicuous, 0.2–0.4 mm long. *Pappus* deciduous, 5–7 mm long, very shortly plumose. (Figure 4)

*Selected specimens examined.* TASMANIA: Mayfield Beach, 10 June 1986, *A.M. Buchanan* 8628 (HO); Port Arthur, *J. Bufton* 6 (MEL); Mt Jukes Rd, 8 Mar. 2000, *L.H. Cave* 191 (CANB, MEL); Launceston, Nov. 1863, *S.G. Hannaford s.n.* (HO); Great Lake, 26 Mar. 1932, *M.J. Hood* 17 (HO); Green Point, west coast, Jan. 1958, *W.D. Jackson s.n.* (HO); near Shot Tower, Browns River Rd, Nov. 1891, *L. Rodway s.n.* (HO); Maria Island, 10 Apr. 2002, *A.C. Rozefelds* 3102 (HO); Cataract Gorge, Launceston, *H.M.R. Rupp* 4 (MEL); Mount Chappell Island, Furneaux Group, 8 Feb. 1972, *J.S. Whinray* 222 (CANB).



Figure 4. *Xerochrysium bicolor* (A.C. Rozefelds 3102, HO 516532).

*Distribution and habitat.* Found in Tasmania in damp situations usually near the coast and often on cliff faces. An apparent variant referred to *X. bicolor* that is sometimes found on disturbed sites in Tasmania, is evidently an introduced weedy form of *X. bracteatum*.

*Notes.* Two specimens in herb. MEL collected by Charles Stuart in Tasmania c. 1848–1849 (of which one is labelled as having come from South Esk River), have broadly elliptic leaves, but in neither specimen is the style tip apparent. They are possibly of a different taxon.

*Xerochrysum bicolor* is very similar to *X. bracteatum* but differs from that species in having denser hispidulous indumentum on the stem, in the sparse arachnoid hairs, in the apparent absence of stipitate glandular hairs, and in the ovate style appendages.

*Lectotypification.* The illustration, t. 1814, that accompanied Lindley's description, was presumably prepared from living material grown by Mr Low, but the origin of his seed is unclear. Since no specimen has been found that purports to be the basis of that illustration, the name is lectotypified on *Gunn* 111 in herb. CGE, which was cited by Lindley in his protologue. During the period 1832–1834, Gunn collected in north-eastern Tasmania (in the general vicinity of Launceston) and it is from here that no. 111 is likely to have been gathered (see Buchanan 1988, 1990).

Lindley, in his herbarium (CGE) and in a note in *A sketch of the vegetation of the Swan River colony* xxii (Lindley 1839), included the yellow-flowered variant of *X. macranthum* from south-west Western Australia under *Helichrysum bicolor*.

**6. *Xerochrysum macranthum*** (Benth.) Paul G. Wilson in Schmidt-Lebuhn *et al.*, *Taxon* 64: 105 (2015). *Helichrysum macranthum* Benth. in Endl. *et al.*, *Enum. Pl.* 65 (1837). *Gnaphalium macranthum* (Benth.) Sch.Bip., *Bot. Zeitung* 3: 171 (1845). *Aphelexis humilis* var. *macrantha* (Benth.) Paxton, *Paxton's Mag. Bot.* 15: 269 (1849). *Aphelexis macrantha* (Benth.) Hereman, *Paxton's Bot. Dict.* 2<sup>nd</sup> edn, 41 (1868). *Type:* Fremantle, Swan River, Western Australia, *K.A. Huegel s.n. (holo: W 0047162 image!)*.

?*Helichrysum glabratum* DC., *Prodr.* 6: 189 (1838). *Gnaphalium glabratum* (DC.) Sch.Bip., *Bot. Zeitung* 2: 171 (1845). *Type:* 'in Nova-Hollandia merid. et orientali. ... (v.s. comm. à Mus. reg. Par. ex itin. Baudin.)' (*syn:* G-DC G00470565 image!, GDC G00470680 image!).

?*Helichrysum bracteatum* var. *albidum* DC., *Prodr.* 6: 189 (1838). *Helichrysum bracteatum* f. *albidum* (DC.) Voss, *Vilmorin's Blumeng.* 3<sup>rd</sup> edn, 1: 534 (1894). *Type:* 'Rarius in hortis colitur. (v.v.c.)', label on specimen in G-DC 'Hort. Genev. 15 octobre 1834' (*syn:* G-DC G 00470178 image!, G-DC G 00470552 image!).

*Helichrysum niveum* Graham, *Bot. Mag.* t. 3857 (1840), *nom. illeg. non* Less. (1832). *Helichrysum nervosum* Donn, *Hortus Cantabrig.* 13<sup>th</sup> edn, 567 (1845). *Helichrysum bracteatum* var. *album* hort. ex L.H. Bailey, *Cycl. Amer. Hort.* 2: 723 (1900). *Type citation:* 'raised by Mr Low of Clapton, from seed sent from Swan River by Mr Drummond' (*syn:* FI 006313 image!, K 000899127 image!).

*Helichrysum robustum* Paxton, *Paxton's Mag. Bot.* 7: 188 (1840), *nom. subnud.* *Type:* Swan River, seed collected by *J. Drummond* (n.v.).

Erect branching annual or short-lived perennial *herb* or *sub-shrub* with woody base, to 1.5 m high. *Stem branches* scabrid, cottony towards apex. *Leaves* narrowly elliptic, 6–9(–20) cm long, acuminate, medial

and lower leaves narrowed to a slender petiole not auriculate at base, chartaceous, sparsely hirsute or scabrid, with minute, sessile, globular glandular hairs, becoming viscid. *Capitula* heterogamous, solitary or terminating branches in an open panicle, subtending foliaceous bracts inconspicuous or linear. *Involucre* hemispherical, to 5 cm diam., with smooth laminae; outer bracts white tinged brown or pink or dusky yellow, rounded, medial bracts white or yellow, obtuse and apiculate, the claw multi-veined. *Style appendages* ovate or triangular. *Achene* smooth; idioblasts indistinct. *Pappus* c. 6 mm long, very shortly plumose. (Figures 5 & 6)

*Selected specimens examined.* WESTERN AUSTRALIA: 3.5 km NW of Chidlow, 8 Nov. 1996, M.G. Allen 398 (PERTH); Pipehead Dam, 2 Nov. 1984, M.G. Corrick 9397 (MEL); 23 km E of Collie, 30 Oct. 1997, R.J. Cranfield 11500 (PERTH); Herne Hill, 6 Sep. 1978, R.J. Cranfield s.n. (PERTH); 6 mi [c. 10 km] N of Cockleshell Gully, 26 Sep. 1976, R.W. Johnson 3271 (PERTH); Lesmurdie, 11 Oct. 2008, K.R. Thiele 3700 (PERTH).

*Distribution and habitat.* Found in the south-west of Western Australia from Geraldton south to Albany. Grows on a variety of substrates and in markedly different habitats including jarrah forest, heathland, riverine flats, or seasonally marshy situations.

*Conservation status.* This species is not considered rare or threatened; however, the habitats of some of the numerous variants appear to be decreasing due to clearing.

*Typification.* The two syntypes of *Helichrysum glabratum* in G-DC probably came from Western Australia since the laminae of the involucre bracts were described as being white; if this is the case then the name would be a synonym of *X. macranthum*.

*Notes.* Near the south-west coast of Western Australia and in the Stirling and Porongurup Ranges, a stunted variant occurs that has dense oblong to obovate leaves and white involucre bracts (see Figure 6). From the herbarium material seen it would appear that this variant has a different habit and a different leaf-shape at each of the many localities where it has been collected but it retains the indumentum and floral characteristics of typical *X. macranthum*. Although the habit, leaf form, and capitulum size of this south-west form are retained in cultivation (G.J. Keighery pers. comm.) it is not recognised here as a distinct taxon since in other characters it is clearly close to the typical form of *X. macranthum* from the south-west of Western Australia with which each of the variants appear to merge (Figure 6).

Examples of this far south-west variant are as follows (all PERTH): Black Hole, Denmark, 9 Dec. 1962, A.S. George 4286; Mt Many Peaks, 23 Nov. 1979, S.D. Hopper 1569; Bluff Knoll, Stirling Range, 28 Feb. 1986, G.J. Keighery 7960; Collier Peak, Porongurup Range, 20 Nov. 1987, G.J. Keighery 8722; Gracetown, 14 Dec. 1994, G.J. Keighery 14766; Devils Slide, Porongurups, Oct. 1963, W. Rogerson 37; Hush Hush Beach, Walpole-Nornalup National Park, 30 Nov. 1992, J.R. Wheeler & S.J. Patrick 3564.

**7. *Xerochrysum papillosum*** (Labill.) R.J. Bayer, *Kew Bull.* 56: 1015 (2001). *Helichrysum papillosum* Labill., *Nov. Holl. Pl.* 2: 46 (1805) t. 192 (1806). *Gnaphalium papillosum* (Labill.) Poir. in Lam. & Poir., *Encycl. Suppl.* 2: 808 (1812). *Xeranthemum papillosum* (Labill.) Poir., *Encycl. Suppl.* 3: 143 (1813). *Helichrysum bracteatum* var. *papillosum* (Labill.) Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přir.* 2: 120 (1923). *Bracteantha papillosa* (Labill.) Anderb. & Haegi, *Opera Bot.* 104: 105 (1991). *Type citation:* 'Habitat in capite Van-Diemen' [Tasmania], J.J.H. de Labillardière (syn: FI 006314 image!, FI 006315 image!, G-DC G00470570 image!).

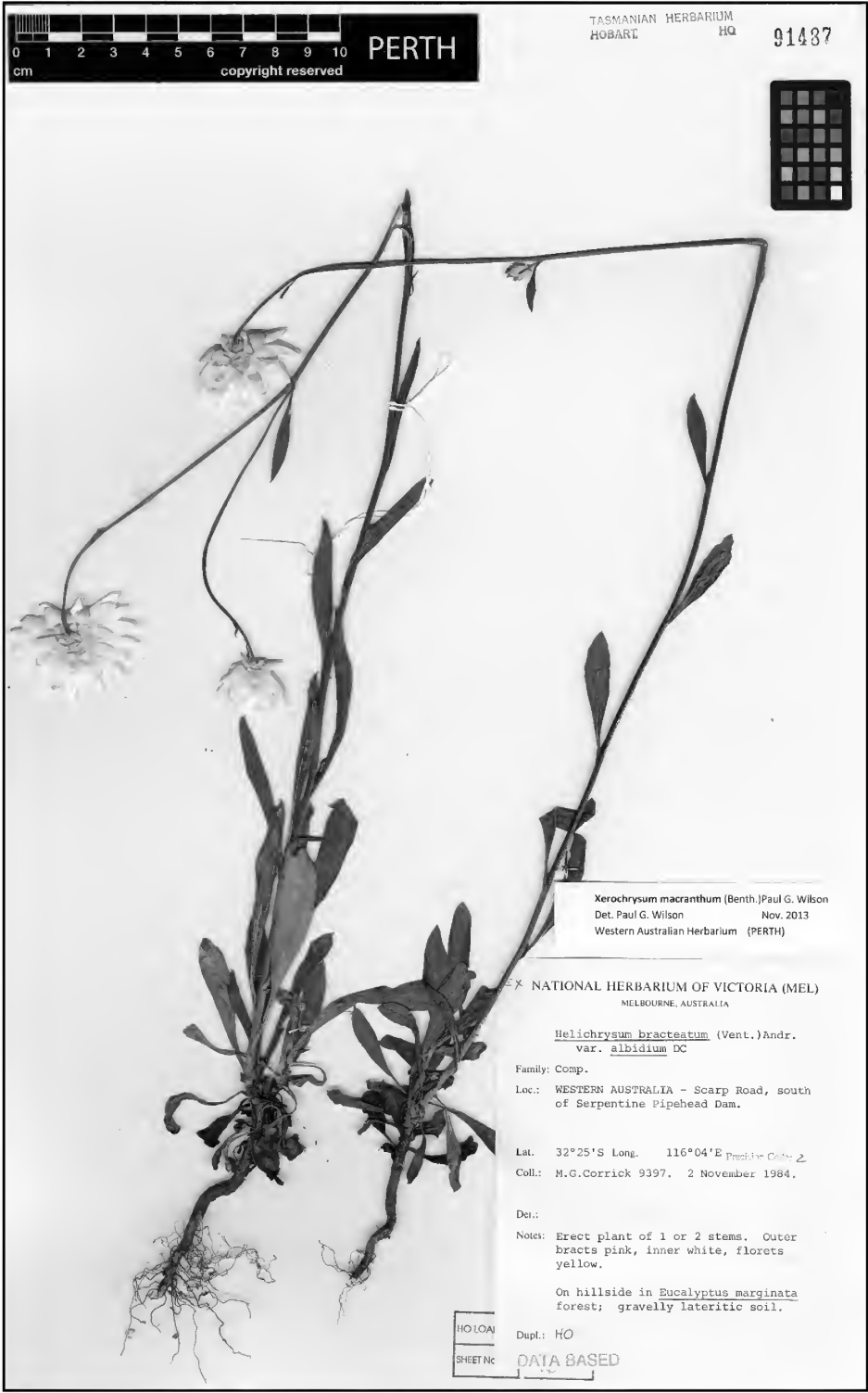


Figure 5. *Xerochrysum macranthum* (M.G. Corrick 9397, HO 91487).



Figure 6. *Xerochrysum macranthum*, Stirling Range–Porongurup Range variant (*W. Rogerson 37*, PERTH 00442577).

Annual or perennial, erect branching *herb* to 1 m high. *Stem branches* and *leaves* glandular-puberulous and scabridulous or hispidulous, sometimes sparsely cottony, faintly glandular-punctate. *Leaves* usually narrowly linear to narrowly elliptic, rarely ovate or obovate, to 10 cm long. *Capitula* terminating stems or branches, subtended by 1–3 leafy bracts. *Involucre* to 4 cm diam.; outer bracts broadly ovate, obtuse, laminae white to pale fawn; medial bracts broadly to narrowly oblong, obtuse to acute, white, the claw multi-veined; inner bracts narrowly oblong and acute to acuminate, white. *Style appendages* rounded to narrowly or broadly ovate. *Achene* smooth, c. 3 mm long, dark brown; idioblasts filiform, c. 0.2 mm long. *Pappus* bristles c. 6 mm long, very shortly plumose, colourless. (Figure 7)

*Selected specimens examined.* VICTORIA: Wilsons Promontory National Park, 10 Nov. 1983, A.C. Beauglehole 75352 (MEL). TASMANIA: Sandy Bay, 22 Nov. 2001, A.M. Buchanan 15854 (HO); South Cape Bay, 5 Apr. 1930, H.F. Comber 2278 (HO); Maatsuyker Island, 8 Mar. 1992, S. Harris s.n. (HO); Sarah Anne Rocks, 4 Nov. 2000, M. Kensey s.n. (HO); Lady Barron, 7 Dec. 2000, T. Rudman s.n. (HO); Great Lake, 31 Mar. 1891, A. Simson s.n. (HO); Long Island, Hogans Group, 7 Dec. 1972, J.S. Whinray 1399 (CANB).

*Distribution.* *Xerochrysum papillosum* occurs on Wilsons Promontory and some off-shore islands of southern Victoria, the Bass Strait islands, and in coastal mainland Tasmania.

*Notes.* The style appendages are narrowly to broadly ovate, with the tip rounded to obtuse (broadly ovate with rounded tip in specimens from Recherche Bay at southern tip of Tasmania, the type locality, while narrowly ovate in Bass Strait). Collections from the Bass Strait islands usually have linear (often revolute) leaves, a morphology that is strongly displayed in specimens that come from Wilsons Promontory and from its neighbouring islands. Specimens from southern Tasmania tend to have narrowly elliptic leaves. The colour of the laminae of medial involucre bracts in the majority of the collections examined was white (as are those of the type) but in some collections from the Bass Strait islands the laminae are pale yellow which is possibly due to intergradation with *X. bicolor* since in other characters some collections suggest a transition between the two.

The leaf morphology in collections from the Bass Strait islands may be due to intergradation with *X. viscosum* since the leaves are sometimes glandular and viscid although the capitula are much larger than in typical *X. viscosum* and the style appendages are rounded, not narrowly triangular-acuminate. Specimens from southern Tasmania may have narrowly elliptic leaves. The leaves were described by Labillardière as being papillose above, in which character he was evidently referring to the short, villous indumentum found on plants of this taxon from the south coast region of Tasmania; however, this, the typical variant, grades northwards into the variant from Bass Strait that has a scabrid pubescence.

The colour of the laminae of the involucre bracts remains the most obvious character that distinguishes *X. papillosum* from *X. bicolor*.

Herbarium material of *X. papillosum* is similar to that of *X. macranthum* from south-west Western Australia and the two species are largely to be distinguished by the shape of the style appendages. However, while the Tasmanian plant is coastal in its distribution the Western Australian plant is predominantly an inland species. It may be more realistic, in view of their morphological similarity, to treat the two populations as representing one species; both populations exhibit considerable variation, and each has both a form with white involucre bracts and a form with yellow involucre bracts. In spite of this, since there are slight but significant differences, such as in the indumentum, in the size of the capitula, and in the stigma shape, I am recognising them as distinct species.



Figure 7. *Xerochrysium papillosum* (A.M. Buchanan 15854, HO 511217).

**8. *Xerochrysum viscosum*** (Sieber ex Spreng.) R.J.Bayer, *Kew Bull.* 56: 1015 (2001). *Helichrysum viscosum* Sieber ex Spreng., *Syst. Veg.* 3: 484 (1826). *Bracteantha viscosa* (Sieber ex Spreng.) Anderb. & Haegi, *Opera Bot.* 104: 105 (1991). *Type*: none cited ['Nov. Holl.' [New South Wales], *F. Sieber* 345, see de Candolle, *Prodr.* 6: 189 (1838)] (*lecto*, here designated: G-DC G 00470540 image!; *isolecto*: HAL 0111515 image!, MEL 604820 image!, W 18890232748 image!).

*Helichrysum bracteatum* var. *viscosum* DC., *Prodr.* 6: 189 (1838). *Type citation*: 'H. viscosum Sieb.! Pl. exs. nov. holl. N. 345. H. bracteato valde affine Cunn.! In litt. 1834. Frequens ad latus occidentium coerul.' *Type specimens*: 'Fl. Novae Holl. No. 345', *F. Sieber* 345 (*lecto*, here designated: G-DC G 00470540 image!; *isolecto*: HAL 0111515 image!, MEL 604820 image!, W 18890232748 image!); 'Frequent in the country on the western side of the Blue Mountains', New South Wales, 1817, A. Cunningham 120 (*syn*: G-DC, G00470545 image!, MEL 61351).

*Helichrysum bracteatum* var. *angustifolium* Guilfoyle, *Austral. Pl.* 209 (1910), *nom. subnud.* *Type*: not indicated.

Viscid, slender, erect, annual/perennial *herb* to 80 cm high, sparingly branched and with perennial rootstock. *Branches* scabrid. *Leaves* mostly cauline, narrowly linear to linear or the lower very narrowly elliptic, 2–8 cm long, 1–2(–6) mm wide, slightly recurved to revolute on margins, densely covered with minute, spherical, viscous sessile glands on both surfaces, otherwise glabrous or scabridulous. *Capitula* terminating slender branches or paniculate, subtended by 1–3 linear *foliaceous bracts*. *Involute* 2–4.5 cm diam., laminae smooth; outer bracts pale reddish brown, rounded to obtuse, apiculate; medial bracts narrowly oblong, yellow, acute, the claw multi-veined. *Style appendages* filiform-acuminate to narrowly triangular-acuminate. *Achene* c. 2 mm long, reddish brown, with thick, crustaceous pericarp; idioblasts linear, c. 0.2 mm long. *Pappus* pale yellow, 6–7 mm long, very shortly plumose. (Figure 8)

*Selected specimens examined*. QUEENSLAND: Wyberba, 23 Jan. 1933, S.T. Blake 4639 (BRI). NEW SOUTH WALES: 48.5 km NE of Coolamon, 25 Nov. 1984, R. Coveny 11989 (CANB); 11.8 km N of Coonabarabran, 3 Aug. 1984, M. Parris 8862A (CANB). AUSTRALIAN CAPITAL TERRITORY: Namadgi National Park, Scabby Range, 11 Mar. 1992, I.R. Telford 11550 (HO, PERTH). VICTORIA: Warby Range, 24 Sep. 1985, A.C. Beaglehole 80882 (MEL); 4 km W of Bailleston, 25 Oct. 1981, M.G. Corrick 7887 (HO); 5 miles [8 km] SE of Rushworth, 7 Nov. 1967, T.B. Muir 4659 (MEL). TASMANIA: Southern Outlet, north bound lane cutting, 15 Dec. 2000, A.M. Gray 1083 (HO).

*Distribution and habitat*. This species is found in the extreme south-east of Queensland and in central and eastern New South Wales, while it is widespread in Victoria; also present (possibly as an introduction) in Tasmania where it is occasionally found along roadsides (*vide* Alex Buchanan pers. comm.). Generally growing in woodland on shallow sandy or loamy soils.

*Chromosome number*.  $n = 12$ , recorded [as *Bracteantha bracteata*] by Watanabe *et al.* (1999: 783), based on the voucher K. Watanabe 218 (MEL).

*Typification*. No type was cited by Sprengel under *Helichrysum viscosum* but since the name was attributed to Sieber and the locality cited as 'Nov. Holl.', it is assumed to be based on a Sieber collection. The only Sieber collection cited by de Candolle is n. 345 a duplicate of which is in his herbarium (G-DC).

The basionym of *Bracteantha viscosa* was cited by Anderberg and Haegi in Anderberg (1991) as '*Helichrysum viscosum* Sieber ex De Candolle, *Prodr.* 6: 189 (1838)' which is incorrect.

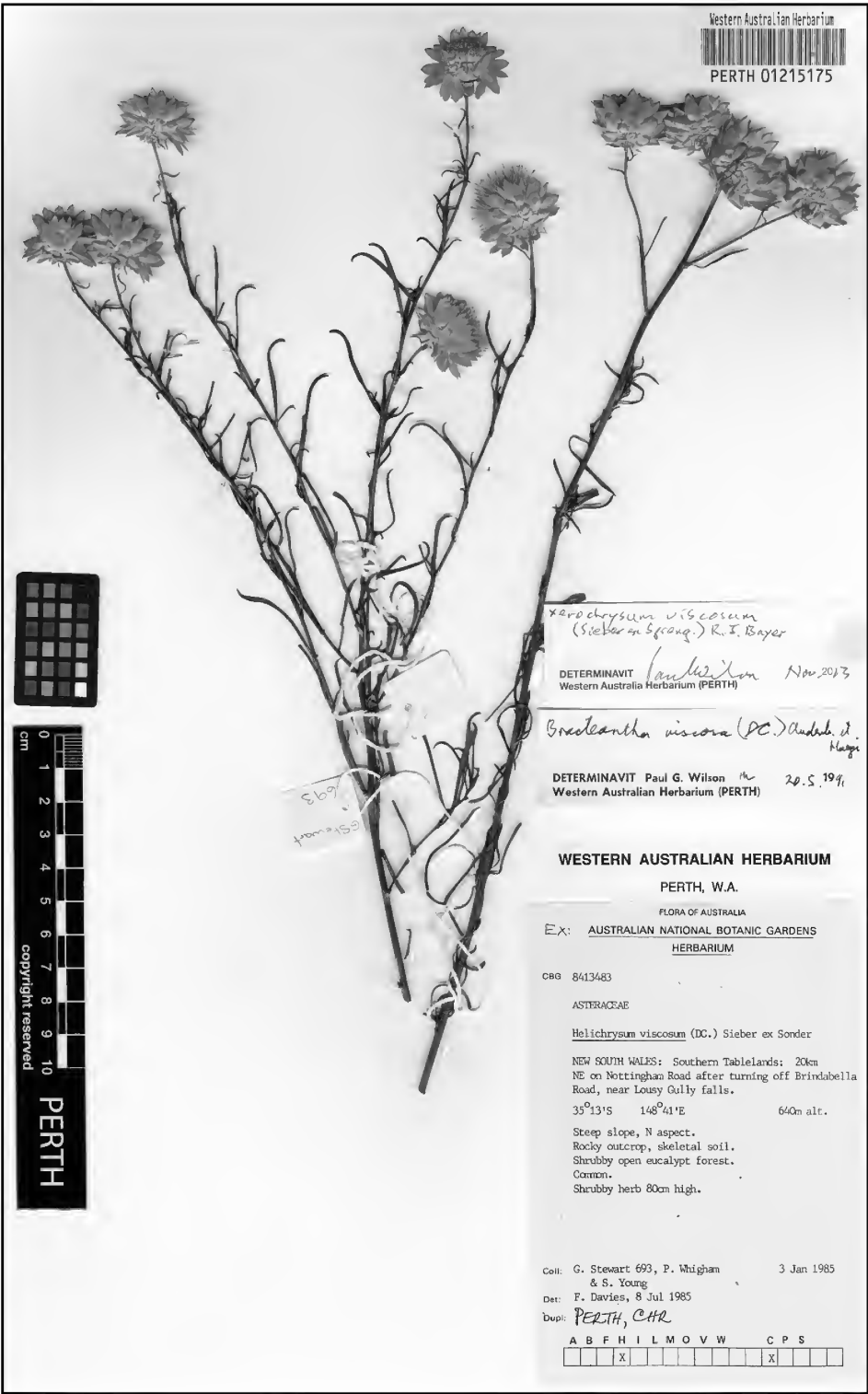


Figure 8. *Xerochrysium viscosum* (G. Stewart 693, PERTH 01315175).

Bayer (2001) cited the basionym of *Xerochrysum viscosum* as '*Helichrysum bracteatum* var. *viscosum* DC. (1838)' and the type as 'Flora Nov. Holl. exs. n. 345'. Since both the Sieber and the Cunningham collections were cited by de Candolle this must be considered to be an incorrect type citation. Bayer added '*non Helichrysum viscosum* Sieb. ex Spreng., Syst. Veg. 3: 484 (1826). Type: Nov. Holl.'. However, although the two names were evidently based on different specimens, but from the same collection, this statement is curious. I am treating Bayer's combination as legitimate but with an incorrect bibliographic citation.

*Notes.* Although *X. viscosum* is treated here as being specifically distinct from *X. bracteatum*, the two species evidently merge and many collections appear to be intermediate in morphology. *Xerochrysum viscosum* may be distinguished from narrow-leaved variants of *X. bracteatum* by its viscid leaves and branches and by the absence of cottony or woolly hairs.

The shape of the cells in the testa and the pattern of thickening in the pericarp appear to be the same as is found in the testa and pericarp of *X. bracteatum*.

This species could be separated into two variants; one with small, narrowly linear leaves often arranged in axillary clusters, and relatively small capitula; the other with longer linear leaves that are not clustered, while the capitula are more prominent. However, these appear to merge and many collections cannot be clearly placed with one or the other of the variants.

**9. *Xerochrysum milliganii*** (Hook.f.) Paul G. Wilson in A.N. Schmidt-Lebuhn *et al.*, *Taxon* 64: 106 (2015). *Helichrysum milliganii* Hook.f., *Fl. Tasman.* 1: 214 (1856). *Type citation*: '(Gunn, 1169). Hab. Summit of Mount Pearse, Surrey Hills, elev. 3000 feet, Mount Sorrell, Macquarie [sic] Harbour, Milligan.' *Type specimens*: Mt Sorell [sic], Macquarie Harbour [Tasmania], 15 January 1847, J. Milligan 755 (*lecto, fide* Paul G. Wilson *op. cit.*: K 000928522!; *isolecto*: K 000928518, K 000928519, K 000928520, MEL 1585997); Mt Pearse, Surrey Hills, Tasmania, R.C. Gunn 1169 (*syn*: K).

*Illustrations.* M. Stones & W. Curtis, *The endemic flora of Tasmania* pt 1: t. 13 (1967); J. Kirkpatrick, *Alpine Tasmania* p. 76, Figure 33e (1997); A.N. Schmidt-Lebuhn *et al.*, *Taxon* 64: 106, Figure 5 (2015), each as *Helichrysum milliganii*.

Low, dense, perennial *herb* with thick, divided rootstock bearing rosette-like leaves. *Flowering stems* erect, to 25 cm high, densely white-cottony. *Leaves* erect, densely imbricate, thick, oblong-elliptic, obtuse to acute, to 2.5 cm long, with broad, stem-clasping base, woolly on margins otherwise glabrous or sparsely glandular-puberulous, grading into involucre bracts. *Capitulum* solitary, to 3.5 cm diam. *Involucre* with bracts spreading at anthesis, erect in fruit; outer bracts ovate, sessile, white to crimson, woolly towards base; medial bracts white, with a narrowly elliptic lamina passing into a semi-terete 1-veined claw, in all to 18 mm long. *Style appendages* rounded. *Achene* cylindrical, c. 3 mm long; pericarp brown, smooth, glossy; idioblasts not apparent; testa brown, cells broad-oblong, not thickened. *Pappus* persistent, with bristles minutely denticulate. (Figure 9)

*Selected specimens examined.* TASMANIA: Mt Rufus, 25 Jan. 1949, N.T. Burbidge 3347 (CANB); Cradle Mtn, 18 Jan. 1976, E. Mullins 209 (CANB); Moonlight Ridge, Hill One, 31 Jan. 1983, P.S. Short 1873 (CANB).

*Distribution and habitat.* Found on the western and central mountains of Tasmania; growing in heath, short grassland, and sedgeland.



Figure 9. *Xerochrysum milliganii* (Hj. Eichler 16489, AD 96108517).

*Notes.* Superficially similar to *X. collierianum* A.M.Buchanan, which also grows in heathland. The divided rhizomatous base produces clumps that have the aspect of a cushion-plant.

**10. *Xerochrysum collierianum*** A.M.Buchanan, *Muelleria* 20: 49, Figures 1, 2 (2004). *Type:* St Valentines Peak, Tasmania, 13 January 1986, *P. Collier* 1206 (*holo:* HO 116970).

*Illustration.* J. Kirkpatrick, *Alpine Tasmania* p. 70, Figure 30d (1997), as *Bracteantha* sp. aff. *bicolor*.

Rhizomatous, perennial *herb* forming dense clumps. *Stems* erect, simple, to 20 cm high, apically minutely glandular-puberulous and very sparsely cottony. *Leaves* minutely glandular, sparsely cottony on margin; *radical leaves* spatulate, to 7 cm long; *cauline leaves* spatulate to narrowly elliptic, 20–50 mm long, diminishing upwards. *Capitula* predominantly solitary, subtended by 2 or 3 foliaceous bracts which grade into the outer lacerate involucre bracts. *Involucre* with smooth, white or rarely pink-tinged laminae; medial bracts with a narrowly elliptic lamina c. 2 cm long and 1-veined claw, not strongly reflexed at maturity. *Outermost florets* female with filiform corolla. *Bisexual florets:* corolla narrowly cylindrical below, narrowly turbinate above, pale yellow; *style appendages* broadly ovate, obtuse. *Achene* 2–3 mm long; pericarp crustaceous, glossy; idioblasts not evident; epidermal cells of testa broadly oblong. *Pappus* persistent.

*Selected specimens examined.* TASMANIA: Mt Claude Lookout, 1 Dec. 2001, *A.M. Buchanan* 15908 (HO); Mt Remus, 13 Jan. 1988, *P. Collier* 3087 (HO); Mt Roland, 7 Apr. 1991, *P. Collier* 5192 (HO); Round Mtn, Mar. 1971, *K. Gillanders* 15 (MEL); Raglan Range, 26 Jan. 1994, *S.J. Jarman* s.n. (HO); Mt Murchison, 13 Feb. 1995, *G. Kantvilas* (HO); summit of Ragged Range, 28 Jan. 1995, *G. Kantvilas* & *S.J. Jarman* s.n. (HO); Gog Range, 1 May 1983, *A. Moscal* 2245 (HO); Mt Claude, 4 Apr. 1988, *A. Moscal* 15683 (HO); Frenchmans Cap, 13 Mar. 1977, *D. Wythes* s.n. (HO).

*Distribution and habitat.* Endemic to western and north-western Tasmania where it is found growing in rock crevices in alpine situations.

*Conservation status.* It is stated by Alex Buchanan, *op. cit.*, that although this species is uncommon more than half of the known occurrences are in national parks or other reserved lands.

*Notes.* Similar in habit and in bract and floral morphology to both *X. alpinum* and *X. milliganii*.

**11. *Xerochrysum palustre*** (Flann) R.J.Bayer, *Kew Bull.* 56: 1015 (2001). *Bracteantha palustris* Flann, *Muelleria* 11: 97 (1998). *Type:* Saplings Morass Flora and Fauna Reserve, Victoria, 11 December 1996, *C. Flann* 1 & *N.G. Walsh* (*holo:* MEL 2036150 image!; *iso:* CANB 528907 image!).

*Helichrysum acuminatum* var. *angustifolium* DC., *Prodr.* 6: 188 (1838). *Type:* ‘in terra Van-Diemen’ [Tasmania], *R.C. Gunn* 247 (*holo:* G-DC G 00470645 image!; ?*iso:* MEL 61301 ).

*Illustration.* C. Flann, *Muelleria* 11: 98, Figure 1 (1998).

Rhizomatous, perennial *herb*, 45–80(–100) cm high. *Stems* usually simple, slender, densely cottony towards apex, otherwise glabrous. *Leaves* all cauline, well-spaced, very narrowly oblong-acuminate, 6–8(–12) cm long, half-clasping at base, flat, glabrous or with cottony hairs on margin. *Capitulum* terminal, solitary, to 4 cm diam., subtended by 1–3 linear, herbaceous, woolly *bracts*. *Involucre bracts* yellow or orange, outer bracts ovate, acute; medial bracts narrowly oblong, acuminate, the lamina

smooth on both surfaces, with a 1-veined claw. *Outer florets* female. *Style appendages* obtuse. *Achene* not seen in mature state; idioblasts not evident. *Pappus* bristles pale yellow, 6–7 mm long.

*Selected specimens examined.* VICTORIA: Surrey River, Gorae, s. dat., *A.C. Beauglehole* 17154 (MEL); 3 km N of Lal Lal, 12 Dec. 1996, *C. Flann* 7 (MEL); Trawalla, 17 Dec. 1991, *R. Thomas* (MEL). TASMANIA: Big Den, 35 km W of Campbell Town, 9 Dec. 1990, *P. Collier* 5024 (HO); Little Hampton, Toiberry, 30 Jan. 1932, *F.H. Long* 1130 (HO); Friendly Beaches Road, Freycinet, 10 Feb. 1984, *A. Moscal* 6168 (HO).

*Distribution and habitat.* Recorded from southern Victoria and eastern Tasmania; confined to wet situations, such as permanent swamps, winter wetlands, and stream margins.

*Notes.* A distinctive species; it is similar to *X. subundulatum* in habit and in the apparent absence of glandular hairs on the leaves, but differs in having smooth involucre bracts.

**12. *Xerochrysum subundulatum*** (Sch.Bip.) R.J.Bayer, *Kew Bull.* 56: 1015 (2001). *Helichrysum acuminatum* DC., *Prodr.* 6: 188 (1838), *nom. illeg. non* (Link) Sweet (1826). *Bracteantha acuminata* Anderb. & Haegi, *Opera Bot.* 104: 105 (1991), *comb. illeg.* *Gnaphalium subundulatum* Sch.Bip., *Bot. Zeitung* 3: 171 (1845). *Bracteantha subundulata* (Sch.Bip.) Paul G.Wilson, *Muelleria* 7(4): 519 (1992). *Type:* Van Diemen Land (Tasmania), *R.C. Gunn* 244 (*holo:* G-DC G 00470677 image!; *?iso:* MEL 61149).

Rhizomatous, perennial *herb* with erect, simple stems *c.* 25 cm high. *Stems* with arachnoid indumentum. *Leaves* semi-amplexicaule, sessile, scattered, diminishing in size upwards; *lower leaves* narrowly oblong to narrowly obovate or oblong-elliptic, 4–7 cm long, apex rounded to obtuse; *upper leaves* narrowly oblanceolate, acute, variably cottony and with sparse, indistinct, and very minute, sessile, spherical glands beneath. *Capitula* solitary, 2.5–6 cm diam., subtended by 2 or 3 linear, herbaceous, cottony bracts. *Involucre* with bracts sometimes not spreading at maturity; outer bracts ovate, acute, ciliate, reddish brown, abaxially minutely scabridulous; medial bracts with a narrowly oblong-acuminate, golden yellow lamina and a 1-veined claw. *Corolla* yellow. *Style appendages* ovate. *Achene* *c.* 2 mm long; pericarp crustaceous, glossy; idioblasts not evident; testa epidermal cells broadly oblong, not thickened. *Pappus* persistent. (Figure 10)

*Selected specimens examined.* NEW SOUTH WALES: Diggers Creek, Kosciuszko National Park, 2 Feb. 1966, *A.M. Ashby* 1737 (AD). VICTORIA: Watchbed Creek, Bogong High Plains, 20 Jan. 1966, *R. Filson* 8110 (MEL); Bidwell, 19 Jan. 1953, *R. Melville* 2959 (MEL); Bentley Flat, below Mt Nugong, 26 Jan. 1953, *R. Melville* 3131 (MEL). TASMANIA: 4 mi (*c.* 6 km) from Guildford Junction, *H.N. Barber s.n.* (HO); Iris River crossing, Wilmot–Cradle Mt Rd, 15 Feb. 1969, *E.M. Canning s.n.* (CANB); Lake Augusta, Central Plateau, 20 Feb. 1972, *D.J. Jarman s.n.* (HO); Breton Rivulet, 2 Feb. 1981, *A. Moscal* 611 (HO).

*Distribution and habitat.* Found in alpine or subalpine areas of eastern Victoria, Tasmania and south-eastern New South Wales, with an outlier in the Kanangra-Boyd National Park in the Great Dividing Range; growing in moist situations in woodland, herbfields and grasslands.

*Notes.* The arachnoid indumentum on the leaf margins is often absent or sparse in collections from the Snowy Mountains.

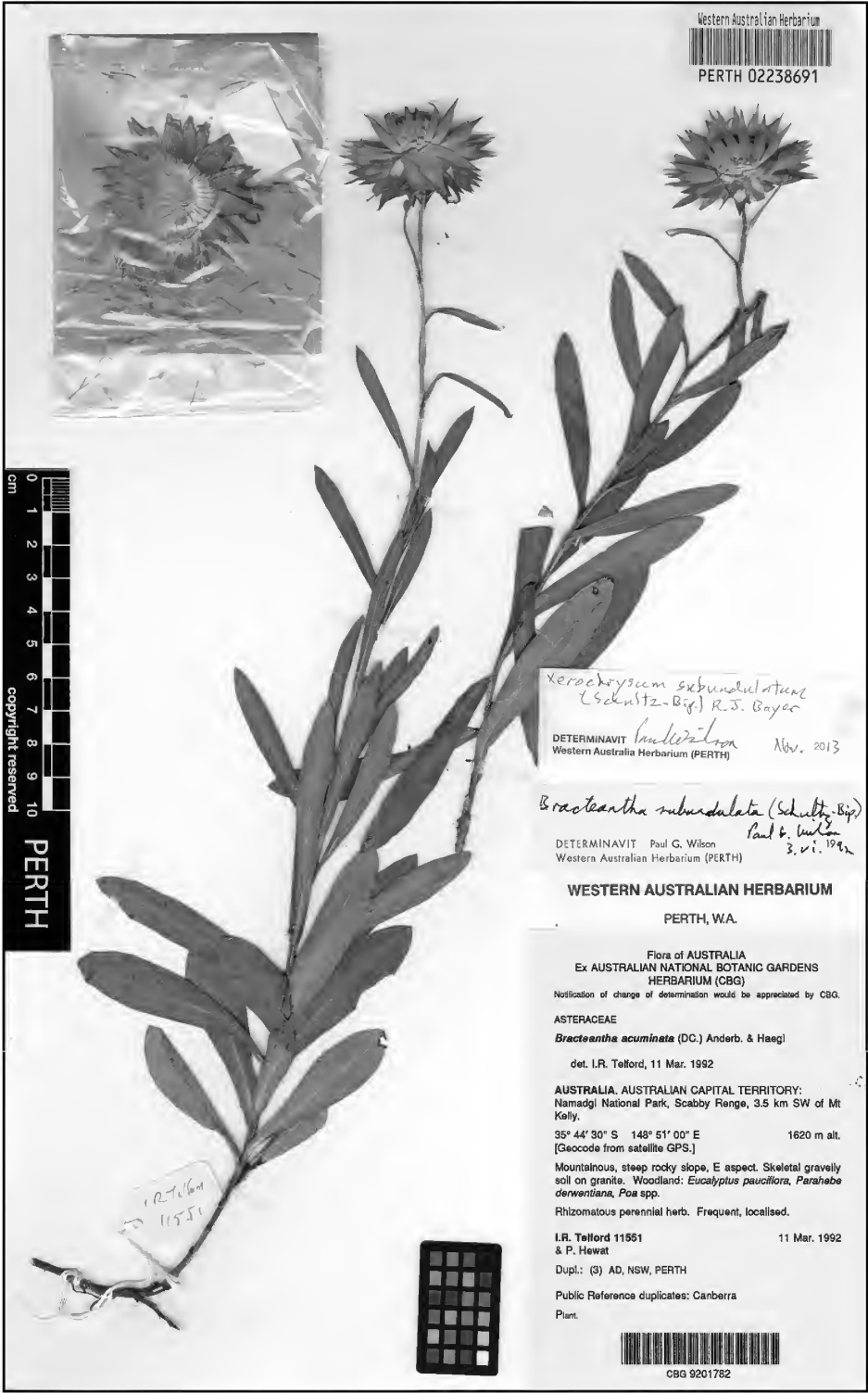


Figure 10. *Xerochrysum subundulatum* (I.R. Telford 11551, PERTH 02238691).

Two collections from the Australian Capital Territory, one from Mt Murray, Namadgi National Park, and the other from Blackfellows Gap, have a habit similar to that of typical *X. subundulatum* but they differ in the virtual absence of cottony hairs on the stem, in their somewhat scabrid leaves, and in their smooth involucre bracts, of which the outer and medial ones have a rounded apiculate (not acuminate) apex. Burbidge and Gray (1970) suggest that this variant may have arisen through hybridisation between *X. subundulatum* and *X. viscosum*. It is possible, however, that they represent an undescribed species of *Xerochrysum*.

### 13. *Xerochrysum alpinum* Paul G. Wilson, *sp. nov.*

*Type*: Lake Lea Road, Tasmania, 17 February 1998, *A.M. Buchanan* 15101 (*holo*: HO 324393).

*Illustration*. J. Kirkpatrick, *Alpine Tasmania* p. 70, Figure 30e (1997) [as *Bracteantha subundulata*].

Rhizomatous, perennial *herb* 8–15(–20) cm high. *Stems* erect, simple-glandular-puberulous and sparsely arachnoid-hairy. *Leaves* crowded towards base of stem, diminishing in size upwards, glandular-puberulous or the lower leaves glabrescent, cottony on margin; *basal leaves* somewhat fleshy, elliptic to obovate, narrowed to a broad petiole, to 5 cm long, apex obtuse to rounded; *cauline leaves* narrowly obovate to oblong, erect, stem-clasping. *Capitula* solitary, c. 4 cm diam., subtended by densely glandular-puberulous foliaceous bracts c. 10 mm long, the uppermost bract with a scarious, rounded, lacerate apex, grading into the involucre bracts. *Involucre* with sessile, reddish brown glands adaxially on the thick claws; outer bracts with a short, broad claw and broadly ovate lamina, acute, scarious with reddish brown tip, abaxially minutely scabridulous; medial bracts narrowly elliptic, yellow, smooth, with a narrowly oblong, 1-veined claw. *Style appendages* rounded. *Achene* not seen in mature state; pericarp glossy; idioblasts not evident. *Pappus* persistent. (Figure 11)

*Selected specimens examined*. TASMANIA: Lake Bill, upper Mersey River, 15 Mar. 1987, *P. Collier* 2289 (HO); Mt Field, Jan. 1945, *W.M. Curtis s.n.* (HO); Pyramid Mtn, 14 Feb. 1983, *A. Moscal* 1780 b (HO); Quamby Bluff, summit, 6 Mar. 1986, *A. Moscal* 12596 (HO); Mt Victoria, 28 Apr. 1980, *M.G. Noble* 29257 (HO); Little Plain, Blue River, Blue Tier, 1 Feb. 1878, *A. Simson* 1056 (HO); Blue Tier, summit, 1 Feb. 1878, *A. Simson* 1101 (MEL).

*Distribution and habitat*. Widespread over alpine Tasmania and growing in peaty herbfields.

*Etymology*. The specific epithet is derived from the Latin *alpinus*, with reference to the mountainous distribution of this species.

*Notes*. *Xerochrysum alpinum* superficially has the appearance of alpine forms of *X. subundulatum* but the former's glandular-puberulous indumentum, and the transition of its uppermost leaves into outer involucre bracts, clearly distinguish the two. No mature achenes were observed.

### Uncertain Name

*Helichrysum macrocephalum* A.Cunn. ex DC., *Prodr.* 6: 188 (1838). *Gnaphalium macrocephalum* (DC.) Sch.Bip., *Bot. Zeitung* 3: 17(1845). *Type*: Moreton Bay, Queensland, sandy shores, Oct. 1824, *A. Cunningham* 121 (*holo*: G-DC G 00328540 image!) [probably a variant of *X. bracteatum*].



Figure 11. *Xerochrysum alpinum* (A. Moscal 12596, HO 403116).

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## An expanded circumscription and new infrageneric classification of *Rinzia* (Myrtaceae: Chamelaucieae)

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### Abstract

Rye, B.L. An expanded circumscription and new infrageneric classification of *Rinzia* (Myrtaceae: Chamelaucieae). *Nuytsia* 28: 39–93 (2017). The circumscription of *Rinzia* Schauer (Myrtaceae tribe Chamelaucieae DC.) is enlarged to encompass species with varied stamen arrangement, filament width and seed morphology. This revision of *Rinzia* s. lat. is based on both morphological and molecular evidence, and establishes five sections within the genus, *Discolora* Rye, *Mesostemon* Rye, *Polyandra* Rye, *Semasperma* Rye and the typical section. All sections occur in Western Australia, with three of them endemic to the south-west, while sect. *Polyandra* also occurs in central Australia and sect. *Semasperma* also occurs in south-eastern Australia. Three new combinations are made for species previously included within *Baeckea* L., and the new name *R. orientalis* Rye is published for *B. crassifolia* Lindl. *Baeckea crassifolia* var. *icosandra* F.Muell. ex Benth. is raised to species rank as *R. icosandra* (F.Muell. ex Benth.) Rye. The other new combinations are *R. ericaea* (F.Muell. ex Benth.) Rye and *R. polystemonea* (F.Muell.) Rye. Four new Western Australian species are described as *R. fimbriolata* Rye & Trudgen, *R. medifila* Rye, *R. torquata* Rye & Trudgen and *R. triplex* Rye & Trudgen, and a new subspecies from Kangaroo Island, South Australia, as *R. ericaea* subsp. *insularis* Rye. *Rinzia morrisonii* Trudgen is reduced to synonymy under *R. longifolia* Turcz. Lectotypes are selected for *Baeckea ericaea* F.Muell. ex Benth. and *R. morrisonii*. Seven Western Australian species have conservation priority.

### Introduction

*Rinzia* Schauer is a reniform-seeded genus of Myrtaceae tribe Chamelaucieae DC. that was reinstated by Trudgen (1986a). Trudgen's delimitation of the genus is not supported by recent molecular studies (e.g. Wilson *et al.* 2004), which have indicated that a wider circumscription is necessary for *Rinzia* to be monophyletic. *Rinzia* s. lat. is readily diagnosed on morphological grounds although it is considerably more variable than any of the five other reniform-seeded genera, *Astus* Trudgen & Rye (Trudgen & Rye 2005), *Enekbatus* Trudgen & Rye (Trudgen & Rye 2010), *Euryomyrtus* Schauer (Trudgen 2001), *Ochrosperma* Trudgen (Trudgen 1987; Bean 1995b, 1997) and *Triplarina* Raf. (Bean 1995a). The greater degree of morphological variation found in the enlarged genus warrants recognition of a number of sections. *Rinzia* s. lat. is revised here and divided into five sections based on a combination of morphological and molecular evidence.

### Taxonomic history (1838–2001)

Early botanists relied on stamen morphology to distinguish *Rinzia s. str.* from other species groups. The first member of *Rinzia s. lat.* to be described, an eastern species with narrow filaments, was initially named *Baeckea crassifolia* Lindl. (in Mitchell 1838). That species was not included when Schauer (1843, 1844) established the genus based on a western species with very broad filaments, *R. fumana* Schauer.

Four more species with broad filaments were named by Lehmann (1848) and Turczaninow (1852) as *B. schollerifolia* Lehm., *R. crassifolia* Turcz., *R. longifolia* Turcz. and *R. oxycoccoides* Turcz. These were followed by the description of two taxa with narrow filaments by Mueller (1858, 1861) as *B. microphylla* var. *ericaea* F.Muell. and *B. polystemonea* F.Muell.

Bentham reduced *Rinzia* to a section of a broadly circumscribed *Baeckea* L. (in Bentham & Hooker 1865), then described *B. dimorphandra* F.Muell ex Benth., which has broad filaments, and *B. crassifolia* var. *icosandra* F.Muell. ex Benth., which has narrow filaments (Bentham 1867). He placed all of the species with broad filaments in *B. sect. Rinzia* (Schauer) Benth. & Hook.f. and those with narrow filaments in *B. sect. Euryomyrtus* (Schauer) Benth. Members of *Rinzia s. lat.* made up the bulk of both sections, with sect. *Euryomyrtus* having only one species now considered to belong in the genus *Euryomyrtus* (and one now placed in *Astus*), while sect. *Rinzia* included one species now placed in *Cyathostemon* Turcz.

Nieden zu (1893) transferred all members of Bentham's sect. *Rinzia* to *Hypocalymma* (Endl.) Endl., which he regarded as differing from *Baeckea* in a number of characteristics of the stamens and style, including the stamens being more erect in bud and more or less united at the base, the anther basifixed and the stigma small. He included the *Rinzia* species under *H. sect. Cardiomyrtus* Schauer, defining this section as having a 3-locular ovary with 2–12 ovules in each loculus and an inset style. However, Bentham's earlier treatment of *Rinzia* as a section of *Baeckea* was followed by most subsequent authors.

A species with stamens of intermediate width was described by Moore (1920) as *B. carnososa* S.Moore. While relatively narrow, the filaments in this species are nevertheless flattened, better matching those of species in *Baeckea* sect. *Rinzia* than *B. sect. Euryomyrtus*, but differing from the former in having versatile anthers.

Trudgen (1986a) reinstated *Rinzia*, treating it as a genus endemic to the south-west of Western Australia and naming a number of new species that have broad filaments. He transferred *B. carnososa*, the species with moderately broad filaments, to *Rinzia*, and suggested that its dorsifixed anthers 'may indicate that the adaxial attachment of anthers in *Rinzia* developed within the genus' (Trudgen 1986a: 427). He regarded *Hypocalymma* as a close relative of *Rinzia* but pointed out that the dorsifixed anthers of *Rinzia* were usually attached on the inner surface of a highly compressed filament, while those of *Hypocalymma* were clearly basifixed, as previously indicated (see above) by Nieden zu (1893).

Trudgen (1986a, 2001) included *Rinzia* in a 'reniform-seeded lineage', in which he mistakenly also included *Balaustion* Hook. and *Hypocalymma* (see Rye & Trudgen 2008; Rye 2009a; Rye *et al.* 2013). However, even after removal of those two genera, the reniform-seeded lineage is not supported as a clade in molecular analyses (e.g. Lam *et al.* 2002).

## Current morphological studies

The current study of *Rinzia*, part of a broader assessment of the tribe Chamelaucieae, began in 2002 and led to the application of manuscript names to several species groups that are here included within *Rinzia*. Trudgen (2001; pers. comm.) had recognised at least three very small species groups within his reniform-seeded lineage that he considered represented new genera, and I established one further group that included *R. carnos*a (S.Moore) Trudgen:

1. ‘*Aethestemon*’ ms, comprising two taxa with multiple staminodes, *Baeckea* sp. Merredin (K.R. Newbey 2506) and *B.* sp. Parker Range (M. Hislop 2968 & F. Hort).
2. ‘*Xeromesos*’ ms, comprising *B. polystemonea* alone, a species similar to ‘*Aethestemon*’ but lacking staminodes.
3. ‘*Semasperma*’ ms, comprising *B. crassifolia*, *B. crassifolia* var. *icosandra* and *B. ericaea*, all of which have seeds with a large, divided cavity on the inner surface. My circumscription of this informal group is given here; Trudgen regarded *B. ericaea* as an additional monotypic genus called ‘*Amischos*’ ms.
4. ‘*Latistemon*’ ms, comprising *R. carnos*a, *B.* sp. Bullfinch (K.R. Newbey 5838) and *Euryomyrtus* sp. Parker Range (N. Gibson & M. Lyons 2269).

‘*Aethestemon*’, ‘*Latistemon*’, ‘*Semasperma*’ and ‘*Xeromesos*’ were included, as unpublished species groups of unspecified authorship and rank, in the key to genera and sections of Western Australian Myrtaceae in Rye (2009b).

## Molecular studies

Lam *et al.* (2002) included two south-eastern Australian and three Western Australian species of *Rinzia* *s. lat.* in a phylogenetic study of Chamelaucieae based on the chloroplast regions *atpB-rbcL* spacer and *matK*. These formed a weakly supported clade. The western species *R. icosandra* (F.Muell. ex Benth.) Rye [as *B. crassifolia* var. *icosandra*] of ‘*Semasperma*’ received somewhat greater, but still weak, support as more closely related to *Rinzia* *s. str.* (two species including the type) than to the south-eastern Australian species *R. ericaea* (F.Muell. ex Benth.) Rye [as *B. ericaea*] and *R. orientalis* Rye [as *B. crassifolia* var. *crassifolia*], although on morphological grounds it appears to be much closer to the latter pair of species.

Wilson *et al.* (2004), in an extended phylogenetic analysis of the Chamelaucieae, sampled ten species of *Rinzia* *s. lat.*, including representatives of all species groups except ‘*Aethestemon*’, and used additional chloroplast regions (5’ *trnK* and *ndhF*). All ten taxa formed a single clade without any extraneous species, although again with relatively weak support. *Rinzia* *s. str.* was not supported as monophyletic within this clade.

Later studies based on the nrDNA ETS marker (Peter Wilson pers. comm.; Rye *et al.* in prep.) place species sampled from all of the sections treated here in a clade comprising *Rinzia* *s. lat.*, with *Enekbatus* weakly supported as sister. Within the clade, the nuclear and chloroplast markers produce different topologies, with the nuclear data indicating that ‘*Semasperma*’, as recognised based on morphological criteria, may be tenable (the western species recognised here as *R. icosandra* has weak to moderate

support in a sister position to a strongly supported clade comprising the two eastern Australian ‘*Semasperma*’ species). All three species are included in sect. *Semasperma* Rye here. The two species of ‘*Aethestemon*’ form a strongly supported group, which is well supported as sister to ‘*Xeromesos*’ in both ETS and chloroplast analyses. Since morphological data also support this relationship, the two species groups are combined here as sect. *Polyandra* Rye. ‘*Latistemon*’, treated here as sect. *Mesostemon* Rye, is strongly supported in all data. One additional group indicated in the chloroplast and ETS data is treated here as sect. *Discolora* Rye.

## Methods

As all species of sections *Discolora* and *Rinzia* have already been revised in Trudgen (1986a), they are given only brief descriptions. Any significant differences from the previously published descriptions are noted, and a number of previously unrecorded characters are scored, notably petal length, style length, seed width and thickness, and aril length. Cited specimens are selected mainly from among the more recently collected material; any specimens correctly cited previously in Trudgen (1986a) are excluded.

Full descriptions are given for all members of the other three sections. All descriptions are based on new measurements taken from dried, adequately pressed material.

Images of overseas and interstate types were examined through *Global Plants* (<http://plants.jstor.org/>). Distribution data were obtained from PERTH specimens, loan specimens from AD, ADW, BRI, CANB, CBG, DNA, MEL, NSW and NT, and additional data sourced from *FloraNT* (Northern Territory Herbarium 2015–) for *R. polystemonea*.

## Morphology

Morphological differences between the sections of *Rinzia* are summarised in Table 1, and many of the characters found in the genus are illustrated in Figure 1.

*Habit and vegetative morphology.* Members of sections *Discolora*, *Rinzia* and *Semasperma* are prostrate or low shrubs, and some produce facultative adventitious roots. The tallest species belong to sect. *Polyandra*, for which the maximum recorded height is 2.5 m. Leaves in sect. *Discolora* are discolorous and have slightly to markedly recurved margins, whereas species in all other sections have concolorous leaves, which are either thicker or have level margins. Leaves in sect. *Polyandra* have crowded oil glands, while those in other sections usually have fewer, sparser glands.

*Inflorescence.* Flowers are usually solitary on each peduncle except in *R. affinis* Trudgen and *R. dimorphandra* (F.Muell. ex Benth.) Trudgen, which have two flowers on most peduncles. Occasional 2-flowered peduncles have also been recorded in *R. crassifolia*. All three species belong to sect. *Rinzia*.

*Calyx and corolla.* All taxa have predominantly pentamerous, white to bright pink flowers. The sepals are much shorter than the petals, with the herbaceous midrib smooth to ridged but not horned, usually with a pale margin (see Figure 1B) surrounding a more herbaceous part that is often deep pink-purple to reddish. The petals are contracted at the base (see Figure 1C); they are deciduous in fruit in most taxa, but seem to persist to some degree in *R. ericaea* and *R. polystemonea*.

*Stamen number and arrangement.* Several inter-related kinds of stamen arrangement are evident within *Rinzia*. In all species one stamen is directly opposite each petal, with the minimum stamen

**Table 1.** Comparison of the sections of *Rinzia*.

Section	<i>Discolora</i>	<i>Mesostemon</i>	<i>Polyandra</i>	<i>Rinzia</i>	<i>Semasperma</i>
<b>Maximum height</b>	0.2 m	1.3 m	2.5 m	1 m	1.3 m
<b>Adventitious roots</b>	often present	absent	absent	sometimes present	sometimes present
<b>Leaves</b>	discolorous	concolorous	concolorous	concolorous	concolorous
<b>Pedicle length</b>	(4–)7–35 mm	0.8–3 mm	1–6 mm	0.8–6.5 mm	0–5 mm
<b>Stamens &amp; staminodes</b>	(5–)10	10	15–30(–36)	(5–)10	5–20
<b>Filament width</b>	broad	medium	narrow	broad	narrow
<b>Anthers</b>	adnate to filament	versatile	versatile	adnate to filament	versatile
<b>Stigma</b>	capitate	capitate	peltate	capitate	capitate or peltate
<b>Ovule number</b>	4–12	3–6	2–5	2–9	2
<b>Fruits</b>	pendulous	erect	erect	pendulous	erect or pendulous
<b>Fertile placentas</b>	brown with paler small markings	brown with paler small markings	blackish with broad white patches	brown with paler small markings	brown with pale linear markings
<b>Seed length</b>	1.3–1.8 mm	1.3–1.5 mm	1.6–2.1 mm	1.3–1.9 mm	1.1–1.6 mm
<b>Seed outer surface</b>	smooth to deeply colliculate	finely colliculate	tuberculate	smooth to ± tuberculate	finely colliculate
<b>Seed inner surface</b>	with a large aril	unmarked except for small hilum	with a circle or a longitudinal ridge	usually with a large aril	with longitudinal divisions
<b>Aril</b>	present	absent	absent	usually present	absent

number therefore being five. Most commonly, there are ten stamens, five antipetalous and five smaller antisepalous ones. This regular arrangement occurs in all species of sect. *Mesostemon* and in most species of sections *Discolora* and *Rinzia*; however two species from the latter sections, *R. fumana* and *R. schollerifolia* (Lehm.) Trudgen, have stamen numbers varying from five to ten.

In the second most common stamen arrangement, triads of stamens are antipetalous, with one large stamen in the middle and two smaller ones on either side of each triad, with or without smaller, antisepalous stamens or staminodes. This pattern characterises sect. *Polyandra* and occurs in some species in sect. *Semasperma*. In sect. *Polyandra*, *R. polystemonea* (F.Muell.) Rye has been recorded with up to 24 stamens, while *R. torquata* Rye & Trudgen has up to 21 staminodes in addition to 15 stamens, giving a total of up to 36 members in the androecium (Figure 1C–E). In *R. ericaea* (sect. *Semasperma*) only 15 stamens are present and there are distinct gaps between the triads; individual stamens within the triads in this species are rarely slightly united into bundles. This pronounced pattern of antipetalous triads, with no antisepalous stamens, is not known in any other Chamelaucieae, although some members of the subtribe Chamelauciinae (DC. ex F.Rudolphi) Arn. have antipetalous triads alternating with solitary antisepalous stamens, making a total of 20 stamens.

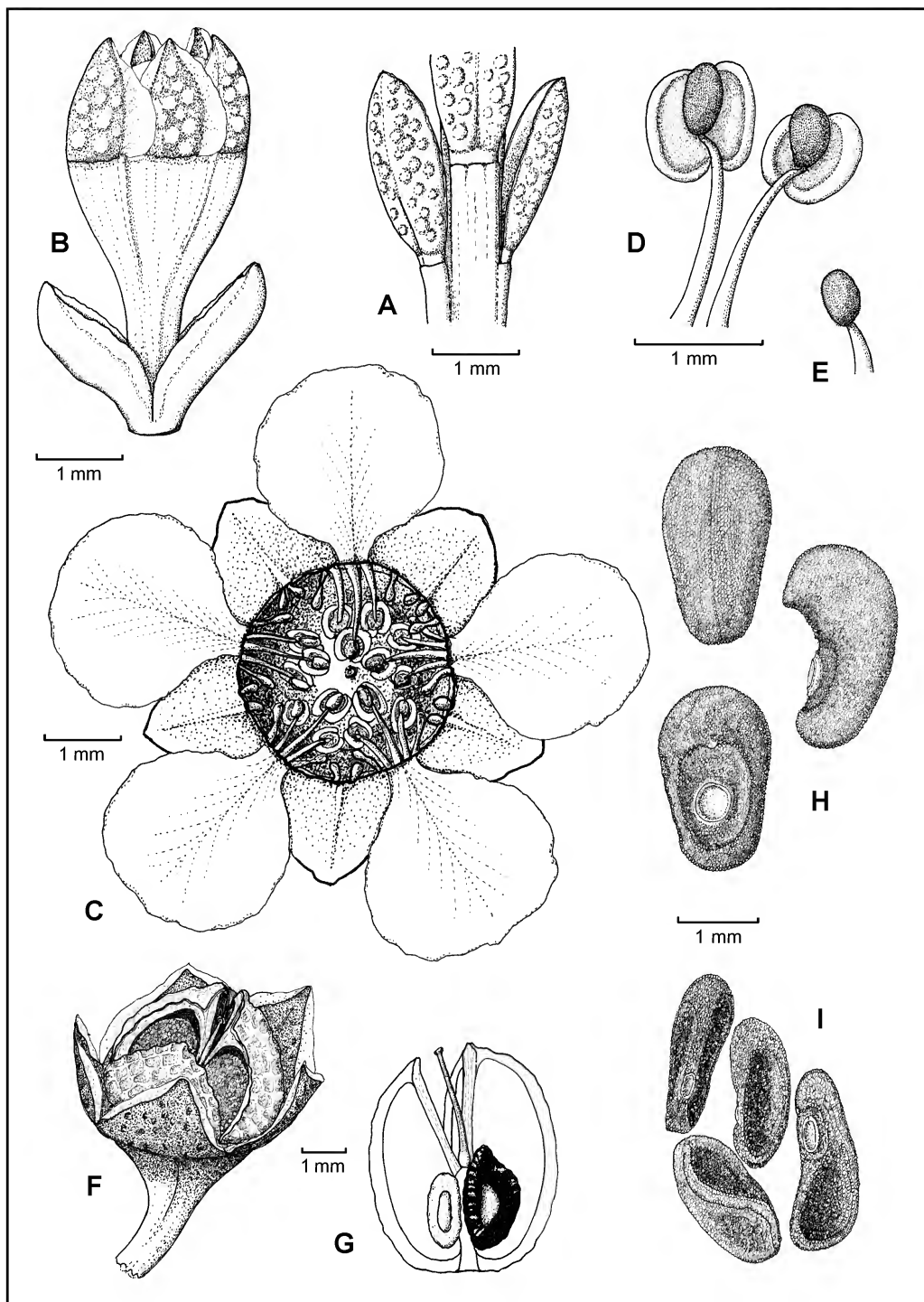


Figure 1. *Rinzia torquata*. A – opposite leaves; B – peduncle, bracteoles, pedicel and flower bud; C – top view of flower; D – stamens; E – staminode; F – fruit; G – LS of fruit showing seed-bearing placenta (on right) and immature or sterile placenta (on left); H – inner, outer and side views of seed; I – chaff pieces. Drawn by L. Cobb from *M. Barrow* 160 (A–E), *J.M. Flint* 33B (F–I).

Two members of sect. *Semasperma*, *R. orientalis* and *R. icosandra*, are very variable in stamen number and could be regarded as bridging the gap between the two main kinds of stamen arrangements described above. Specimens of these two taxa have stamen numbers ranging from five, all antipetalous, to 20. Each adjacent pair of large antipetalous stamens is separated by 0–3 smaller, usually equidistant stamens. Where a full 20 stamens occur in a flower, there is a regular arrangement with ten of them directly opposite a sepal or petal and ten in the gaps between them, i.e. occurring both opposite and alternating with the petals and sepals.

*Filaments.* In sections *Discolora* and *Rinzia* the antipetalous and antisepalous stamens are dorsiventrally compressed and commonly laterally fused (as in *R. sessilis* Trudgen; see Trudgen 1986a: Figure 1), with the width of the androecial tube thus formed contracting towards the top where it surrounds the stigma. This is very similar to the shape of the androecium in *Cyathostemon* species, which show a similar concentration of species towards the south coast of Western Australia, suggesting that the two genera have the same pollination syndrome. The other sections usually have all filaments free and not so crowded around the stigma.

*Anthers.* *Rinzia* includes species with the primitive myrtaceous anther morphology, as found in the great majority of genera in the family as a whole. The anther is broad, dorsifixed and versatile, with parallel, longitudinally dehiscent thecae and a free, subterminal, dorsal connective gland (Figure 1D). However, all species in sections *Discolora* and *Rinzia* have non-versatile anthers inserted on the inner surface of a broad filament that usually extends distinctly above the top of the anther loculi.

*Staminodes.* Staminodes occur consistently in two members of sect. *Polyandra*. As illustrated in Figure 1E, the staminodes have a normal-sized, functional connective gland but the thecae are usually completely absent. Staminodes occur regularly in a number of other genera of Chamelaucieae, and in some cases are quite elaborate, but those in sect. *Polyandra* are unique in retaining a bare connective gland.

*Ovary.* The ovary is 3-locular and has two to 12 reniform ovules in each loculus. Where there are only two ovules, their arrangement is collateral. Where there are three to five ovules, the ovule attachment points are arranged in an arch, with no attachments across the base of the placenta but with one directly at the summit of the placenta if the ovule number is uneven. If the ovules are more numerous, they may appear to be in two rows rather than forming an arch, although there are still no attachments across the base of the placenta.

*Style.* The base of the style is immersed within a cylindrical depression in the summit of the ovary and extends down to the level of attachment of the placentas (see Figure 1F, G). The stigma varies from small and capitate to flattened and peltate; when peltate it is up to about 0.3 mm in diameter. Style length, a character that was not recorded in the revision of *Rinzia s. str.* (Trudgen 1986a), is much less variable than in other genera of a similar size in the tribe, although it is used twice in the key to the species below. This contrasts with the extremely variable between-species variation in style length in many other genera of Chamelaucieae (it is the single most useful character in distinguishing species within the tribe), and suggests that species in *Rinzia s. lat.* show little variation in their pollination strategy.

*Fruits.* All species have a 3-valved capsule (Figure 1F) that varies from 1/2-inferior to about 3/4-superior, with some of the superior part of the fruit closely surrounded by the free part of the hypanthium. Capsules are described as ‘pendent’ in *Rinzia s. str.* (Trudgen 1986a: 421). The valves usually open very widely, to well beyond the erect position. Fruiting placentas vary in size, shape and colouring

between the sections, and the seeds also show significant differences (see below). In sect. *Polyandra*, seed-bearing placentas are very dark red-brown, appearing virtually black (Figure 1G), contrasting with the white attachment points of the seeds. Immature or infertile placentas (Figure 1G) are smaller, and white to pale brown. Other sections have less obvious, usually brown placentas.

*Seeds and chaff.* All species have more or less kidney-shaped seeds (see Figure 1H), a three-dimensional shape referred to here as reniform, although the more common botanical usage of this term is for the two dimensional shape that is kidney-shaped in profile. It appears that ant-dispersal of the seeds is favoured in sections *Discolora* and *Rinzia* since almost all species have an obvious free aril surrounding the hilum (see Trudgen 1986a: Figure 2). Seeds of sect. *Semasperma* have a large cavity with two stiff divisions, while those of two species of sect. *Polyandra* have a large, circular hilum (Figure 1H). Among species that have only two ovules in each loculus, the maximum possible seed set of six seeds per fruit is sometimes achieved. Chaff pieces (unfertilised ovules or early-aborted seeds) may be variable in the same fruit or loculus, some very flattened, others thicker and crumpled (Figure 1I) or more angular than the seeds, often pale brown and crustaceous.

## Taxonomy

*Rinzia* is most likely to be confused with five other genera that have multi-locular fruits with reniform seeds and dorsifixed, longitudinally dehiscent anthers with an obvious, free connective gland. These six reniform-seeded genera are readily distinguished in the key below.

### Key to reniform-seeded genera

1. Ovary 2–5-locular, sometimes with one loculus sunken below the others or with 2 superposed ovules in each loculus. Fruits fully indehiscent or with 2 upper loculi dehiscent and a somewhat lower loculus indehiscent
  2. Flowers ± sessile. Hypanthium circular in TS. Ovary loculi usually all with 2 ovules. Fruits with all of the 2–5 loculi at the same level, fully indehiscent ..... **ENEKBATUS**
  2. Flowers stalked. Hypanthium 5-angled. Ovary loculi with up to 7 ovules, most with more than 2 ovules. Fruits with loculi at 2 overlapping levels, lower level with an indehiscent loculus and upper level with 2 dehiscent loculi ..... **ASTUS**
1. Ovary 3-locular in all or most flowers, with all loculi at the same level, the ovules collateral, arched or in 2 rows. Fruits with all loculi dehiscent
  3. Stamens antisepalous, with none opposite the centre of a petal (northern and eastern Australia)
    4. Stamens 5–8. Ovules 2 per loculus. Seeds 1–1.5 mm long, with longitudinal dips or furrows separating continuous rows of tubercles, arillate ..... **OCHROSPERMA**
    4. Stamens 11–18. Ovules 4–14 per loculus. Seeds 0.5–0.8 mm long, uniformly covered by discrete tubercles, without an aril ..... **TRIPLARINA**
  3. Stamens in varied arrangements, always with antipetalous stamens present (central and southern Australia)
    5. Leaves with parallel venation usually visible on upper surface. Peduncles 0.5–9 mm long, usually about as long as to distinctly longer than the pedicels. Antipetalous colleters forming prominent groups (absent in one eastern species) ... **EURYOMYRTUS**
    5. Leaf venation obscure or not as above. Peduncles 0–0.6(–1) mm long, usually much shorter than the pedicels. Antipetalous colleters (when present) free, inconspicuous ..... **RINZIA**

**Rinzia** Schauer, *Linnaea* 17: 239–240 (1843); *Baeckea* sect. *Rinzia* (Schauer) Benth. & Hook.f., *Gen. Pl.* 1: 701 (1865). *Type*: *Rinzia fumana* Schauer.

Prostrate to tall *shrubs*, when low-growing sometimes producing adventitious roots, with glabrous stems and flowers. *Leaves* opposite and decussate, glabrous on both surfaces but sometimes with ciliate or lacinate margins. *Peduncles* very short or almost absent, 1-flowered in most species, 2-flowered in a few species. *Bracteoles* persistent in most species, with incurved margins or somewhat folded, sometimes wider from side view than dorsal view. *Pedicels* much longer than peduncles or (in *R. ericaea*) almost absent. *Hypanthium* adnate at base to ovary but free for much of its length, often rugose-pitted. *Sepals* 5, much shorter than petals, erect or slightly spreading, persistent in fruit, with a hyaline or pale margin, the more herbaceous centre tending to be dark pink to reddish. *Petals* widely spreading, broadly obovate to circular, white to bright pink, deciduous in fruit in most species,  $\pm$  entire. *Antipetalous colleters* few or absent, free, minute and inconspicuous. *Staminodes* absent in most species, when present up to 21, antisepalous, reduced to a stalked connective gland. *Stamens* 5–24, in a single series, connate at the base in many species, antipetalous ones always present but antisepalous ones sometimes absent, incurved. *Antipetalous filaments* larger than filaments in other positions, markedly compressed to  $\pm$  terete. *Anthers* dorsifixed, either attached at front of a broad filament or versatile, with parallel, longitudinally dehiscent cells; connective gland free, subterminal, globular or ellipsoid. *Ovary* largely superior to largely inferior, 3-locular; summit often becoming deep pink or reddish, dotted with oil glands; ovules 2–12 per loculus, collateral when 2, arched or in 2 rows when more numerous. *Style* slender; base deeply inset into summit of ovary. *Fruits* largely superior (rarely *c.* 1/2-inferior in sect. *Semasperma*), thick-walled, dehiscent by 3 valves, rugose on the hypanthium and/or valves. *Seeds* reniform, often somewhat broader above the middle, 1.1–2.1 mm long, in many taxa with a large whitish aril, in others sometimes with a large inner cavity or large hilum; testa crustaceous, smooth to tuberculate, brown or black, somewhat shiny.

*Size and distribution.* A genus of five sections and 19 species, occurring in central and southern mainland Australia, with the majority of species endemic to the south-west of Western Australia. The distributions of the sections are shown in Figures 2 and 3.

*Etymology.* Named after two horticulturalists of Frankfurt, Sebastian Rinz (1782–1861) and his son Jacob Rinz (1809–1860).

### Key to sections of *Rinzia*

1. Stamens regularly 10 in most species, but down to 5 in two species. Antipetalous filaments flat, 0.25–1 mm wide. Seeds either with a large, free-margined aril or with a colliculate testa, with no large cavity on the inner surface
  2. Antipetalous filaments 0.25–0.6 mm wide, attenuate at apex; antisepalous filaments free. Anthers with a narrow dorsal attachment at slender summit of filament. Seeds lacking an aril..... sect. **Mesostemon**
  - 2: Antipetalous filaments 0.5–1 mm wide, emarginate, truncate or obtuse; antisepalous filaments (when present) united shortly at base or for half to nearly their full length to the antipetalous filaments. Anthers attached to the inner surface of filament. Seeds with an obvious aril in most species
3. Leaves thin, with margins slightly to prominently recurved, discolorous. Pedicels (4–)7–37 mm long..... sect. **Discolora**
- 3: Leaves thick in most species, if flat then with level margins, concolorous. Pedicels 0.8–4(–6.5) mm long.....sect. **Rinzia**

- 1: Stamens 5–24, of variable number in all species. Antipetalous filaments  $\pm$  terete (at least in distal half),  $< 0.25$  mm wide. Seeds lacking a free-margined aril, either tuberculate or with a large, partitioned cavity on the inner surface
4. Androecium with 5–20 stamens but no regularly occurring staminodes. Ovules 2 per loculus. Seeds 1.1–1.6 mm long, with a large, concave inner cavity that is longitudinally divided into 3 parts; testa colliculate .....sect. **Semasperma**
- 4: Androecium with 16–36 members consisting of triads of stamens opposite the petals and shorter stamens or staminodes opposite the sepals. Ovules 2–5 per loculus. Seeds 1.6–2.1 mm long, without a divided cavity but sometimes with a large, fairly flat hilum on the inner surface; testa tuberculate .....sect. **Polyandra**

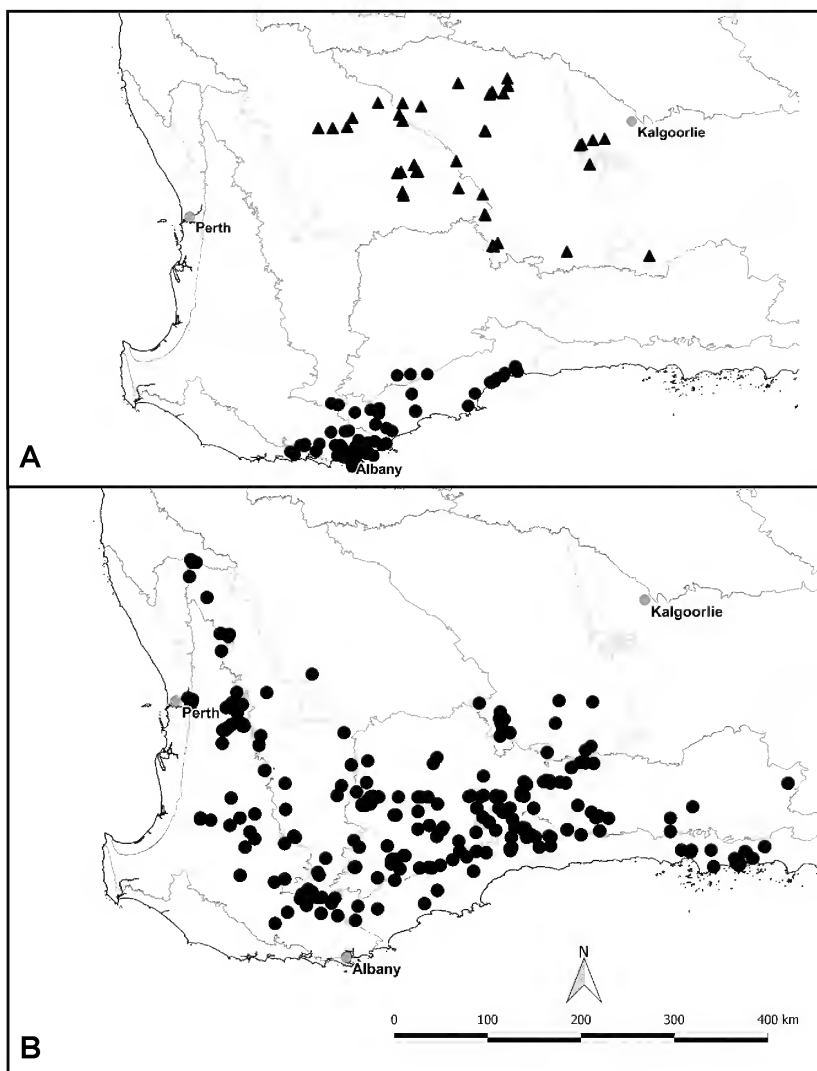


Figure 2. Distributions of the endemic south-western Australian sections of *Rinzia*. A – sect. *Discolora* (●) and sect. *Mesostemon* (▲); B – sect. *Rinzia* (●).

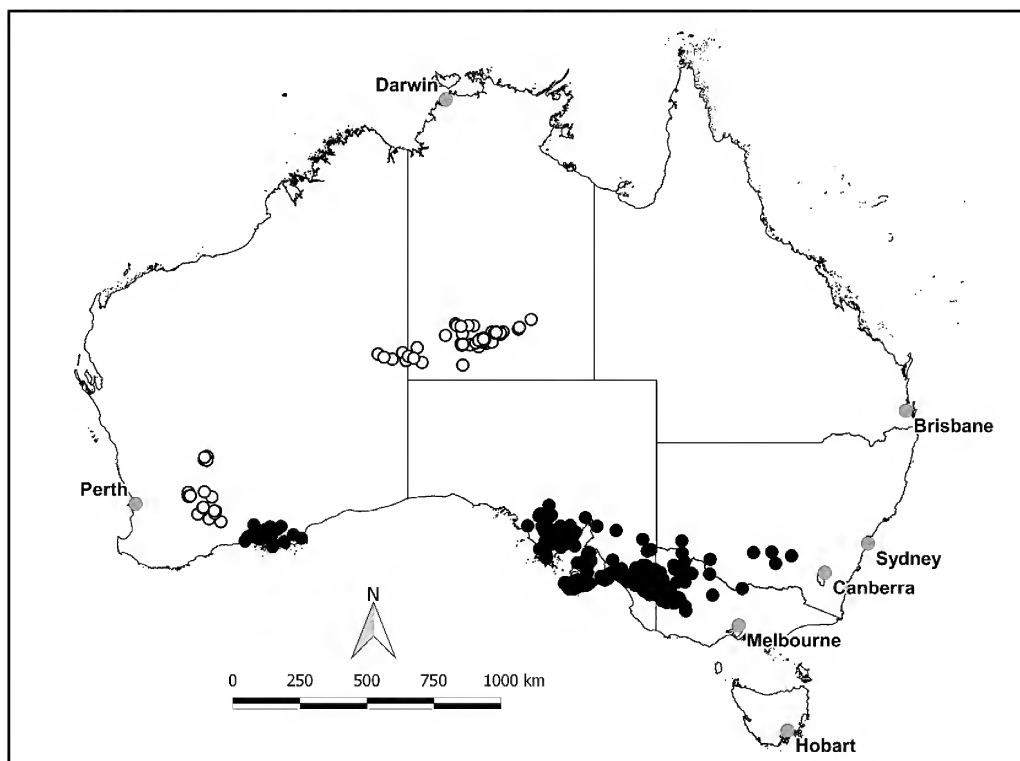


Figure 3. Distributions of sections of *Rinzia* that extend beyond Western Australia, sect. *Polyandra* (○) and sect. *Semasperma* (●).

### Key to species of *Rinzia*

*Note.* Species are listed alphabetically within each section and are numbered consecutively below for the entire genus.

1. Ovules 2 per locus
2. Filaments  $\pm$  terete in distal half,  $< 0.25$  mm wide. Seeds with a large, longitudinally partitioned cavity on inner surface, or with a fairly flat hilum and no aril
3. Stamines 10–21. Seeds 1.6–1.8 mm long, tuberculate; inner surface with a large, flat hilum and no partitions (Merredin–Hatter Hill, WA) ..... **8. *R. torquata***
3. Stamines absent or few. Seeds 1.1–1.5(–1.6) mm long, colliculate; inner surface with a large cavity that is longitudinally divided into 3 parts
4. Flowers  $\pm$  sessile within persistent bracteoles. Sepals usually with an obvious pale midrib. Stamens 15, in discrete groups of 3 opposite the petals (Kangaroo Island, SA–Big & Little Deserts, Vic.) ..... **17. *R. ericaea***
4. Flowers on a pedicel 0.8–5 mm long, the bracteoles caducous or deciduous. Sepals not obviously ribbed or outer ones with a dark keel. Stamens 5–20,  $\pm$  equidistant, usually not all in groups of 3 opposite the petals
5. Pedicels 0.8–1.5 mm long. Sepals very dark-coloured, darker than hypanthium. Stamens 5–13 (Eyre Peninsula & Kangaroo Island, SA–lower Darling & Murrumbidgee Rivers area, NSW–Ballarat area, Vic.) ..... **19. *R. orientalis***

- 5: Pedicels 1.3–5 mm long. Sepals not much darker than the hypanthium.  
Stamens (11–)13–20 (Lort River area–Israelite Bay, WA)..... **18. *R. icosandra***
- 2: Filaments of antipetalous stamens flat throughout, (0.3–)0.5–1 mm wide. Seeds with no large cavity, arillate
- 6: Leaves sessile, sometimes sparsely ciliolate to densely ciliate (N of Mt Holland–near Pyramid Lake–Poinier Rock, WA) ..... **16. *R. sessilis***
- 6: Leaves with a petiole 0.2–0.5 mm long, glabrous
- 7: Leaves often 4-ranked, very thick. Antipetalous filaments not or scarcely 2-horned at summit, with papillae inconspicuously coloured and extending down but becoming sparser below summit of filament, i.e. not forming a definite terminal band (Frank Hann NP–Gnowangerup–Young River area, WA)..... **11. *R. communis***
- 7: Leaves not regularly 4-ranked, usually distinctly broader than thick. Antipetalous filaments often distinctly 2-horned at summit, terminating in a white band of papillae
- 8: Flowers 6–8 mm diam. Stamens 5–10, variable between flowers rather than uniformly 10. Mature style 0.7–1.1 mm long. Seeds 1.3–1.5 mm long, smooth or colliculate, with a slight beak adjacent to each end of the aril (Brookton Hwy–Collie–Kalgan River area, WA) ..... **14. *R. fumana***
- 8: Flowers 7.5–13 mm diam. Stamens 10 in all or nearly all flowers. Mature style 1.1–1.6 mm long. Seeds 1.5–1.9 mm long, deeply colliculate to tuberculate, not beaked or rarely beaked at one end only (Watheroo–near Perth–Brookton, WA) ..... **12. *R. crassifolia***
- 1: Ovules 3–12 in all or most loculi
- 9: Stamens 15–24, with staminodes (when present) increasing the total number of elements to a maximum of c. 35. Filaments ± terete
- 10: Androecium with 16–24 stamens and no staminodes; antipetalous filaments 1.2–1.7 mm long. Seeds with a small hilum (Rawlinson Ra. area, WA–Harts Ra. area, NT)..... **7. *R. polystemonea***
- 10: Androecium with 15 stamens and 5–21 staminodes; antipetalous filaments 0.8–1.3 mm long; staminodes with a connective gland but no thecae. Seeds with a large flat hilum
- 11: Leaf blades 0.5–0.6 mm wide, about as thick as wide; abaxial surface either uniformly curved or flattened for most of its width. Staminodes 5–11. Ovules usually 3 in all loculi of the ovary, rarely 4 in some or most loculi (Die Hardy Ra.–Parker Ra.–Bullabulling, WA)..... **9. *R. triplex***
- 11: Leaf blades 0.8–1.2 mm wide, mostly distinctly wider than thick; abaxial surface with a flattened section down the centre, which is narrower than the margins and often hollowed down the middle. Staminodes 10–21. Ovules usually 2 in all loculi of the ovary, rarely with a combination of 2- and 3-ovulate loculi (Merredin–Hatter Hill, WA) ..... **8. *R. torquata***
- 9: Stamens 5–10(–12), without staminodes. Filaments flattened
- 12: Stamens 10, free. Antipetalous filaments 0.25–0.6 mm wide, attenuate or somewhat narrowed distally, with versatile anther protruding well above filament's apex. Seeds lacking an aril
- 13: Young leaves very rugose-glandular. Mature leaves 0.5–0.8 mm thick, entire (Bencubbin–Coolgardie–near Hunt Ra.–near Norseman, WA)..... **4. *R. carnosa***

- 13: Young leaves not very rugose. Mature leaves up to 0.4 mm thick, with minutely fringed margins
- 14: Leaves thick. Antipetalous filaments 1.2–1.4 mm long, 0.4–0.6 mm wide. Mature style 2–2.7 mm long (Southern Cross area, WA) ..... **5. *R. fimbriolata***
- 14: Leaves fairly flat. Antipetalous filaments 0.6–0.8 mm long, 0.25–0.35 mm wide. Mature style 1.2–1.8 mm long (Parker Ra., WA) ..... **6. *R. medifolia***
- 12: Stamens 5–12; antisepalous filaments (when present) united very shortly or for up to c. 1/3 of their length to the antipetalous filaments. Antipetalous filaments 0.5–1 mm wide, emarginate, truncate or obtuse, with non-versatile anther attached to the inner surface and often exceeded by filament's apex. Seeds with an obvious aril in most species (very reduced or apparently absent in *R. rubra*)
- 15: Leaves thin, with margins slightly to prominently recurved, discolorous. Mature pedicels (4–)7–37 mm long
- 16: Leaves obtuse. Ovules 8–12 per loculus. Seeds shortly tuberculate (Fitzgerald River NP, WA) ..... **2. *R. oxycoccoides***
- 16: Leaves acute. Ovules 4–8 per loculus. Seeds  $\pm$  smooth
- 17: Flowers 5–8 mm diam. Stamens scarcely united at base. Ovules 4–6 per loculus, mostly 5. Aril 0.5–0.7 mm long (near Parry Inlet–near Bremer Bay, WA) ..... **3. *R. schollerifolia***
- 17: Flowers 8–13.5 mm diam. Stamens united for c. 1/4–1/3 of length of antisepalous filaments. Ovules 5–8 per loculus, mostly 6–8. Aril usually 0.8–1 mm long. (Stirling Ra.–Jerramungup, WA) ..... **1. *R. longifolia***
- 15: Leaves usually thick, rarely thin and with level margins, concolorous. Mature pedicels 0.8–4(–6.5) mm long
- 18: Anther loculi protruding beyond apex of filament. Ovules 4–9 per loculus. Seed minutely tuberculate; aril absent or rudimentary (Frank Hann NP–Bremer Ra., WA) ..... **15. *R. rubra***
- 18: Anther loculi usually exceeded by filament, only the connective gland protruding. Ovules 3(–5) per loculus. Seed smooth; aril obvious, 0.6–1 mm long
- 19: Leaves commonly overlapping the pair above by 1/5 or more of their length. Flowers white or pale pink (near Harrismith–Lake King, WA) ..... **10. *R. affinis***
- 19: Leaves rarely overlapping the pair above, and if so by no more than 1/5 of their length. Flowers usually pale to deep pink (near Esperance–Howick Hill, WA) ..... **13. *R. dimorphandra***

***Rinzia* sect. *Discolora*** Rye, *sect. nov.*

*Typus: Rinzia longifolia* Turcz.

Prostrate or low, spreading *shrubs*, often with adventitious roots. *Leaves* thin, discolorous, with denticulate to lacinate, slightly to markedly recurved margins. *Peduncles*  $\pm$  absent or rarely up to 0.5 mm long, 1-flowered. *Bracteoles* persistent, entire or denticulate. *Pedicels* (4–)7–37 mm long. *Hypanthium* commonly minutely pitted. *Petals* white to bright pink. *Staminodes* absent. *Stamens* 5–10, usually 10 opposite the sepals and petals, when 5 then antipetalous, scarcely connate at base or for up to c. 1/3 of the length of antisepalous filaments. *Antipetalous filaments* flattened, (0.4–)0.5–0.8(–1) mm

wide; apex  $\pm$  reaching or exceeding top of anther, often emarginate, with whitish papillae. *Anthers* attached on inner surface of filament, not versatile. *Ovary* c. 1/2-inferior; ovules 4–12 per loculus. *Style* 1.2–2.3 mm long; stigma capitate. *Fruits* pendulous, largely superior. *Seeds* 1.3–1.8 mm long, smooth to deeply colliculate, medium to dark brown or black; inner surface with a large, whitish aril.

*Diagnostic features.* Distinguished from all other sections of *Rinzia* in having thin, distinctly discoloured leaves, and usually longer pedicels. Other important characters are: stamens normally 10, opposite sepals and petals; filaments flat, slightly to markedly connate; ovules 4–12 per loculus; seeds arillate.

*Distribution and phenology.* Endemic to the south-west of Western Australia (Figure 2A). The three species of sect. *Discolora* are geographically distinct; two of them have a relatively small distribution, which is located in each case just beyond the much larger range of the third species, *R. schollerifolia*. All of them tend to have long flowering periods, probably related to their occurrence near the south coast where rainfall is less seasonal than in central and northern parts of the south-west.

*Etymology.* From the Latin *discolor* (variegated, not of uniform colour), referring to the discoloured leaves.

*Notes.* Young leaves are obviously denticulate to lacinate in this section, but older leaves may become more or less entire.

**1. *Rinzia longifolia*** Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg* 10: 331 (1852). *Type:* Swan River colony [Stirling Range to Cape Riche to Mt Barren Range, Western Australia, 1848], *J. Drummond* coll. 5: 121 (*holo:* KW 001001297; *iso:* G 00227681, MEL 73045, PERTH 01053477).

*Rinzia morrisonii* Trudgen, *Nuytsia* 5: 423–424 (1986). *Type:* on Stirling Range Drive to Red Gum Pass, c. 9 km north-west of Chester Pass turnoff, Stirling Range National Park, Western Australia, 1977, *E.N.S. Jackson* 3329 (*lecto:* AD 97749414, here designated).

*Illustration.* M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, second row on right (1986) [as *R. morrisonii*].

*Shrub* usually 0.1–0.2 m high, 0.2–0.6 m across, prostrate or scrambling, producing adventitious roots from prostrate main stems. *Petioles* 0.3–0.8 mm long. *Leafblades* narrowly oblong to ovate, 3–10.5 mm long, 1.3–2.3 mm wide, acute; margins slightly to distinctly recurved, minutely denticulate to lacinate. *Bracteoles* 2–3.5 mm long. *Pedicels* 10–37 mm long. *Flowers* 8–13.5 mm diam. *Hypanthium* 1.5–2.3 mm long. *Sepals* 1.1–2.5 mm long, denticulate or  $\pm$  entire. *Petals* 3–6 mm long, white or pink. *Stamens* 10, connate for 0.4–0.6 mm. *Antipetalous filaments* 1.4–2 mm long, 0.5–0.7 mm wide. *Antisepalous filaments* 0.8–1.3 mm long, 0.3–0.5 mm wide. *Anthers* 0.35–0.5 mm long. *Ovules* (5?) 6–8 per loculus. *Style* 1.4–2.3 mm long. *Fruits* 2–3 mm long. *Seeds* 1.4–1.8 mm long, 0.55–0.8 mm wide, 0.8–1 mm thick,  $\pm$  smooth, reticulate; aril 0.8–1 mm long.

*Diagnostic features.* Distinguished from other members of sect. *Discolora* by the following combination of characters: leaves acute; flowers 8–13.5 mm diam.; stamens united at base for c. 0.5 mm; ovules usually 6–8 per loculus.

*Selected specimens examined.* WESTERN AUSTRALIA: Hume Peak, Stirling Range, 1 Oct. 1995, *S. Barrett* 519 (PERTH); 1 km W of Moingunup Swamp, Stirling Range, 12 May 1982, *G.J. Keighery* 4853 (PERTH); Stirling Range, Oct. 1867, *F. Mueller* s.n. (MEL 76203); near Gold Hole, Chester Pass,

Stirling Range, Nov. 1983, *K.R. Newbey* 9816 (PERTH); Corackerup Nature Reserve, 4 Nov. 1992, *C.J. Robinson* 1000 (PERTH); Monjebup North, 10 Aug. 2016, *E.M. Sandiford* EMS 2325 (PERTH).

*Distribution and habitat.* Widespread in Stirling Range National Park, extending north-east to Jerramungup. Occurs in sandy soils or clay, usually in heath or mallee shrubland, sometimes on rocky hillsides or associated with watercourses.

*Phenology.* Flowers mainly from August to November, with mature fruits recorded in October and November.

*Conservation status.* *Rinzia longifolia* was listed by Jones (2015) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora; however, its enlarged circumscription has led to its status being downgraded to Priority Three (Western Australian Herbarium 1998–). The recorded range of *R. longifolia* is now over 100 km long with populations in Stirling Range National Park, Corackerup Nature Reserve and another relatively protected site.

*Etymology.* From the Latin *longi* (long-) and *-folius* (-leaved). *Rinzia longifolia* has longer leaves on average than other members of the genus except for *R. crassifolia* and *R. schollerifolia*.

*Common name.* Creeping *Rinzia*.

*Typification.* According to the protologue of *R. morrisonii* (Trudgen 1986a: 423) the holotype is lodged at PERTH and isotypes at AD, CANB and K. However, the holotype and the CANB and K isotypes cannot be located and there is no evidence on the AD specimen that duplicates were ever distributed. Since all attempts to relocate the missing material have failed, the AD isotype is selected here as the lectotype.

*Notes.* Trudgen (1986a) described *R. longifolia* s. str. in his key as ‘Plants with main stems prostrate and branchlets erect, short, usually densely leaved; antepetalous stamens 1.9–2.4 mm long’, whereas his new species *R. morrisonii* was described as ‘Plants variable in form (including prostrate) but otherwise not as above; antepetalous stamens 1.6–1.8 mm long’. The two species were considered to be allopatric, with *R. morrisonii* restricted to the Stirling Range and *R. longifolia* occurring to the north-east. Elsewhere, Trudgen compared both taxa to *R. schollerifolia* rather than to one another, justifying the recognition of *R. longifolia* s. str. on its distinctive habit, which he considered to be ‘unique in the genus and indeed in the subtribe Baeckeinae’ (Trudgen 1986a: 423, 425). While he did collect material from one population of *R. morrisonii* he did not visit any populations of *R. longifolia* s. str., basing his assessment of its habit purely on the four old herbarium collections cited in his paper. However, there is no clear difference in habit evident from the herbarium specimens placed under the two taxa, and stamen lengths also do not fall into two distinct categories. Furthermore, two recent collections (*C.J. Robinson* 1000 & *E.M. Sandiford* EMS 2325) have increased our knowledge of *R. longifolia* s. str., and it is now clear that habit is too variable to be taxonomically informative: Libby Sandiford (pers. comm.) observed both kinds of habit occurring intermixed within a single large population.

Specimens collected in the Stirling Range have longer leaves and smaller flowers on average than those of *R. longifolia* s. str. but show considerable overlap in their measurements for all organs. As the total variation observed within the group has no discontinuities there appears to be no firm basis for recognising species or even subspecies. Many other species of *Rinzia* show a similar or greater range of morphological variation. Consequently, *R. morrisonii* is reduced here to a synonym of *R. longifolia*.

**2. *Rinzia oxycoccoides*** Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersbourg* 10: 331 (1852). *Hypocalymma oxycoccoides* (Turcz.) Nied., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3(7): 99 (1893). *Type*: south-western Australia [Stirling Range to Cape Riche to Mt Barren Range, Western Australia, 1848], *J. Drummond* coll. 5: 120 (*holo*: KW 001001298; *iso*: BM 001015092, G 00227680, K 000843236, MEL 72892 & 72893, NSW 547593, PERTH 01139479).

*Baeckea oxycoccoides* Benth., *Fl. Austral.* 3: 75 (1867), *nom. illeg.* *Type*: south-western Australia [Stirling Range to Cape Riche to Mt Barren Range], Western Australia, 1848, *J. Drummond* coll. 5: 120 (*syn*: BM 001015092, G 00227680, K 000843236, KW 001001298, MEL 72892 & 72893, NSW 547593, PERTH 01139479).

*Illustrations*. Drawings on C.A. Gardner 2971 (PERTH); W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 69 (1980) [as *Baeckea oxycoccoides*]; M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, third row on left (1986).

*Sub-shrub* usually c. 0.1 m high, prostrate or almost so, up to 1 m wide. *Petioles* 0.5–1 mm long. *Leaf blades* narrowly ovate-oblong to almost circular, 2–7(–8) mm long, 1.5–3.2(–3.5) mm wide, obtuse; margins prominently recurved, denticulate to shortly laciniate. *Bracteoles* 1.5–2(–3.5) mm long. *Pedicels* 10–35 mm long. *Flowers* 10–15(–19) mm diam. *Hypanthium* 1.7–3.3 mm long. *Sepals* 1–1.7 mm long, ciliate-denticulate to laciniate. *Petals* 4–6(–8.5) mm long, white to bright pink. *Stamens* 10, scarcely connate. *Antipetalous filaments* 1.5–2.3 mm long, 0.4–0.8(–1) mm wide. *Antisepalous filaments* 1.3–1.8 mm long, 0.3–0.8 mm wide. *Anthers* 0.35–0.5 mm long. *Ovules* 8–10(–12) per loculus. *Style* 1.5–1.8 mm long. *Fruits* 3–3.5 mm long. *Seeds* 1.6–1.8 mm long, c. 0.75 mm wide, c. 1 mm thick, shortly tuberculate; aril c. 1 mm long.

*Diagnostic features*. Distinguished from other members of sect. *Discolora* by its obtuse leaves, 8–12 ovules per loculus, and tuberculate seeds.

*Selected specimens examined*. WESTERN AUSTRALIA: Thumb Peak, 15 Nov. 1995, S. Barrett 518 (PERTH); on track between Quoin Head Rd and Whalebone Beach, Fitzgerald River National Park, 10 Oct. 2003, M. Hislop 3045 (NSW, PERTH); Whoogarup Range, SE spur, Fitzgerald River National Park, 26 Sep. 1997, F. Obbens 4/97 (PERTH); Two Bump Hill summit, Fitzgerald River National Park, 26 Jan. 1994, C.J. Robinson 1198 (PERTH).

*Distribution and habitat*. Extends from Eyre Range south-west to Mt Bland, Fitzgerald River National Park. Occurs on rocky hillsides and low summits, often in quartzite, in shrublands rich in Proteaceae and Myrtaceae.

*Phenology*. Flowers recorded from September to January, and mature fruits from October to January.

*Conservation status*. This species is not considered to be under threat. Its known range is about 70 km long and falls entirely within Fitzgerald River National Park.

*Etymology*. The epithet refers to the resemblance of this *Rinzia* to the Cranberry genus *Oxycoccus* Hill, now treated as a synonym of *Vaccinium* L. (Ericaceae). See also the etymology of *R. schollerifolia* below.

*Common name*. Large-flowered *Rinzia*.

*Notes.* Several of the type specimens cited above give the year as 1849, perhaps the year when material was received in Europe, but the specimens from this part of Drummond's fifth collection were picked in 1848 (see Erickson 1969). The G isotypes of both species give the year as 1848 and the PERTH isotypes have been corrected to this date.

*Rinzia oxycoccoides* differs from other members of sect. *Discolora* in having obtuse leaves and the stamens scarcely united. It normally has white or pink flowers of 10–15 mm diameter. One spectacular collection from the north-eastern end of the distribution (*A.S. Weston* 12797) has the largest flowers recorded in the genus; they are bright pink and c. 19 mm diameter. This collection also has much larger bracteoles (3–3.5 mm long) than the other specimens and the largest leaves with the greatest laceration of their margins. However, there is one other specimen from the same general area (*A.S. George* 7252) that seems much more similar to the specimens from the remainder of the range.

**3. *Rinzia schollerifolia*** (Lehm.) Trudgen, *Nuytsia* 5: 422 (1986). *Baeckea schollerifolia* Lehm., *Pl. Preiss.* 2: 369 (1848). *Hypocalymma schollerifolium* (Lehm.) Nied., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3(7): 99 (1893). *Type:* Seven Mile Bridge [c. 11 km N of Albany], Western Australia, Oct. 1840, *J.A.L. Preiss* 2015 (*syn:* LD 1088747, M 0170961, MEL 73042–73044, S S07-11672, ?W [photograph PERTH 01631861]).

*Illustrations.* Drawings on *E.H. Wilson & D.A. Herbert* 337 (PERTH); W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 69 (1980) [as *Baeckea schollerifolia*]; M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, third row on right (1986).

*Sub-shrub* 0.05–0.2 m high, up to 0.6 m wide, low-growing, sometimes with adventitious roots from prostrate main stems. *Petioles* 0.3–1 mm long. *Leaf blades* ovate or narrowly ovate, 4–11 mm long, 1.3–2.5 mm wide, acute; margins usually slightly to distinctly recurved, denticulate. *Bracteoles* 1.6–3 mm long. *Pedicels* 4–22 mm long. *Flowers* 5–8 mm diam. *Hypanthium* 1.4–3 mm long. *Sepals* 1–1.7 mm long, denticulate. *Petals* 2.5–3.5 mm long, white to bright pink. *Stamens* 5–10, very shortly connate. *Antipetalous filaments* 1.2–1.7 mm long, 0.5–0.8 mm wide. *Antisepalous filaments* (when present) 0.7–1.3 mm long, 0.3–0.4 mm wide. *Anthers* 0.25–0.4 mm long. *Ovules* 4–6 per loculus. *Style* 1.2–1.4 mm long. *Fruits* 2–2.8 mm long. *Seeds* 1.3–1.6 mm long, 0.6–0.7 mm wide, 0.75–0.9 mm thick, smooth, minutely reticulate; aril 0.5–0.7 mm long.

*Diagnostic features.* Distinguished from other members of sect. *Discolora* by the following combination of characters: flowers 5–8 mm diam.; stamens 5–10, scarcely united at the base; ovules 4–6 per loculus; seeds smooth, with aril 0.5–0.7 mm long.

*Selected specimens examined.* WESTERN AUSTRALIA: Woodlands Block, Porongurup Range, 5 Oct. 2000, *A. Burchell* 415 (PERTH); Old Railway Reserve, c. 2 km W from Happy Valley Rd, Denmark Shire, 13 Oct. 1999, *B.G. Hammersley* 2276 (PERTH); 1 km W from Kordabup Rd, 8 Sep. 2000, *B.G. Hammersley* 2630 (PERTH); Goode Beach, Torndirrup, 18 km SSW of Albany, 27 July 1986, *G.J. Keighery* 8210 (PERTH); W of Pfeiffer Rd, South Stirling Nature Reserve, 5 Oct. 2006, *E.M. Sandiford* EMS 1308 (PERTH); 1 km along Pfeiffer Rd from intersection with Pleasant Rd [c. 7 km NE of Manypeaks], 2 Sep. 1986, *P.S. Short* 2658, *M. Amerena & B.A. Fuhrer* (PERTH).

*Distribution and habitat.* Occurs from near Parry Inlet east to near Bremer Bay, often associated with laterite or granite or in sandy winter-wet flats, in a variety of vegetation types including Jarrah forest.

*Phenology.* Flowers and fruits from July to December.

**Conservation status.** This species is recorded from many localities, including Two Peoples Bay Nature Reserve and South Stirling Nature Reserve, within a range more than 200 km long, and is not considered to be under threat.

**Etymology.** The epithet refers to the resemblance of the leaves to those of *Schollera* Roth (Ericaceae). *Schollera*, like *Oxycoccus* (see the etymology of *R. oxycoccoides* above), is now treated as a synonym of *Vaccinium*.

**Common name.** Cranberry Rinzia.

**Notes.** Of the species included in sect. *Discolora*, *R. schollerifolia* has the smallest flowers and the fewest ovules on average, and is the only species to sometimes have the number of stamens reduced below ten, even down to five (lower than recorded in Trudgen 1986a). Its ovule number reaches a higher level than recorded previously, being up to six per loculus.

**Rinzia** sect. **Mesostemon** Rye, *sect. nov.*

**Typus:** *Rinzia carnosa* (S.Moore) Trudgen.

‘*Latistemon*’ ms in B.L. Rye, *Nyctisia* 19: 320 (2009).

Spreading or erect *shrubs* up to 1.3 m high, with very slender stems. *Leaves* concolorous, obtuse. *Peduncles* almost absent or up to 0.6 mm long, 1-flowered. *Bracteoles* persistent. *Pedicels* 0.8–3 mm long. *Petals* white to medium pink. *Staminodes* absent. *Stamens* 10 in all or most flowers, opposite the sepals and petals, free. *Antipetalous filaments* flattened, 0.25–0.6 mm wide; apex narrow, well below top of anther. *Anthers* versatile. *Ovary* largely superior; ovules 3–6 per loculus, in an arch. *Style* 1.2–2.7 mm long; stigma capitate. *Fruits* fairly erect, largely superior (3/4–4/5-superior). *Seeds* (where known) 1.3–1.6 mm long, medium brown to black, finely colliculate; inner surface without an aril or any other large features, with a hilum up to c. 0.2 mm diam. somewhat above middle.

**Diagnostic features.** Differs from all other sections of *Rinzia* in having stamens with a free filament that is flattened but only of medium width. Other important characters are: stamens 10, opposite sepals and petals; ovules 3–6 per loculus; seeds non-arillate.

**Distribution and phenology.** Endemic to the south-east of Western Australia, occurring in the central inland part of the South West Botanical Province and the adjacent part of the Eremaean Botanical Province (Figure 2A). Although the three species of sect. *Mesostemon* are not known to co-occur, both *R. fimbriolata* and *R. medifila* Rye & Trudgen occupy a small area near the centre of the range of the much more widespread species, *R. carnosa*. Flowering is more seasonal in sect. *Mesostemon* than in sections *Discolora* and *Rinzia*, occurring in winter and spring, from July to October, especially in August and September.

**Etymology.** From the Greek *meso-* (middle-) and *-stemon* (-stamen), referring to the intermediate width of the stamen filaments in comparison with the broad filaments of sections *Discolora* and *Rinzia* and the narrow filaments of sections *Polyandra* and *Semasperma*.

**Notes.** The group now known as sect. *Mesostemon* was included in Trudgen (1986a) but only one of the three species recognised here was described. Although the anthers are versatile in this section,

they do not appear to be as flexible as in sections *Polyandra* and *Semasperma*.

**4. *Rinzia carnososa*** (S.Moore) Trudgen, *Nuytsia* 5: 426 (1986). *Baeckea carnososa* S.Moore, *J. Linn. Soc. Bot.* 45: 175 (1920). *Type*: Bruce Rock, Western Australia, 1916, *F. Stoward* 315 (*holo*: BM 001015091; *iso*: MEL 72570).

*Baeckea minutifolia* Cheel, *J. & Proc. Roy. Soc. W. Austral.* 10: 5 (1923). *Type*: Westonia, Western Australia, April 1918, *F.M.C. Schock s.n.* (*holo*: NSW 122996 & 536430 [see *Typification* below]).

*Illustrations*. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 68 (1980) [as *Baeckea carnososa*]; M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, bottom row on right (1986); drawings on *C.A. Gardner* 2746.

*Shrub* 0.3–1.2 m high, 0.35–1.3 m wide; flowering branchlets with 1 or 2 pairs of flowers. *Leaves* appressed or rarely slightly overlapping on young branchlets, distant and appressed on older branchlets. *Petioles* absent or up to 0.2 mm long. *Leaf blades* broadly obovate to almost circular in outline, 0.8–2(–2.5) mm long, 0.5–1.2 mm wide, 0.5–0.8 mm thick, obtuse, entire; adaxial surface shallowly concave to flat; abaxial surface deeply convex and irregularly marked by sunken oil glands with 1 row of usually 2–4 large oil glands on each side of midvein. *Bracteoles* 0.7–1.3 mm long, entire. *Pedicels* 1–3 mm long. *Flowers* 7–9.5 mm diam. *Hypanthium* 1.7–2.1 mm long, 2.2–2.8 mm diam.; free portion c. 0.7 mm long. *Sepals* depressed-ovate, 0.5–1 mm long, 1.2–1.5 mm wide, entire. *Petals* 2.3–3.7 mm long, white or pale pink, possibly sometimes rose pink. *Antipetalous filaments* commonly 1.3–1.5 mm long, 0.3–0.6 mm wide. *Antisepalous filaments* 0.5–0.7 mm long, 0.3–0.5 mm wide. *Anthers* 0.3–0.4 mm long. *Style* 1.7–2.7 mm long; stigma 0.1–0.2 mm diam. *Ovules* 3–6 per loculus. *Fruits* 1.7–2.4 mm long, 2.1–2.3 mm diam. *Seeds* 1.3–1.6 mm long, 0.6–0.7 mm wide, 0.65–0.8 mm thick; testa dark brown or black.

*Diagnostic features*. Within sect. *Mesostemon*, this species has the thickest, most rugose leaves and is the only one with entire leaves and entire sepals.

*Selected specimens examined*. WESTERN AUSTRALIA: ex Jaurdi Station (proposed Conservation Park), 5 Oct. 2005, *V. Clarke* VJC 566 (PERTH); 5 km E of Bullabulling on Great Eastern Hwy, 27 Aug. 1997, *G. Flowers* 65 & *S. Donaldson* (CBG, PERTH); c. 2.8 km SE of Bungalbin Hill, [Helena &] Aurora Range, 24 Sep. 1995, *N. Gibson & M. Lyons* 2805 (PERTH); on flats E of Hunt Range and SW of Karrajong Rockhole, 20 July 1995, *N. Gibson & M. Lyons* 3694 (PERTH); 6.05 km S of railway line at Koonadgin Siding, SE of Merredin, 4 Nov. 2004, *B.L. Rye* 241144 & *M.E. Trudgen* (PERTH); c. 15 km SE of Bonnie Rock, 18 Sep. 2001, *L.W. Sage, C. Swift & R. Watson* WW 43-41 (PERTH); Westonia, Oct. 1918, *F.M.C. Schock s.n.* (BRI 225362, NSW, PERTH).

*Distribution and habitat*. Extends from Bencubbin east to Coolgardie and from near Hunt Range south-east to near Norseman. Recorded mostly from lateritic or granitic sites, with a wide variety of associated shrub species, including *Acacia* thickets.

*Phenology*. Flowers recorded from July to October, with mature fruits in September.

*Conservation status*. This species is fairly widespread and is not considered to be at risk.

*Etymology*. From the Latin *carnosus* (fleshy) as this species has fleshy leaves.

*Common name.* Fleshy-leaved Rinzia.

*Typification.* The only type material known for *B. minutifolia*, a synonym of *R. carnosa*, is mounted on NSW 122996, but letters and documents relating to this specimen have been mounted on a separate sheet, NSW 536430. Hence there are two sheet numbers given for the holotype.

*Notes.* One of the specimens cited above, *L.W. Sage, C. Swift & R. Watson* WW 43-41, has particularly fleshy leaves, up to 1.2 mm wide and 0.8 mm thick, noticeably larger than those of the other specimens examined.

According to Trudgen (1986a: 427), flowers have a diameter of 5.5–7.5 mm and there are sometimes up to 12 stamens, with two stamens opposite some sepals. A larger flower size of 7–9.5 mm diameter was recorded here, and all flowers checked had ten stamens.

### 5. *Rinzia fimbriolata* Rye, *sp. nov.*

*Typus:* north of Southern Cross, Western Australia [precise locality withheld for conservation reasons], 21 September 1978, *R.J. Cranfield* 661 (*holo:* PERTH 05885906; *iso:* CANB).

*Baeckea* sp. Bullfinch (K.R. Newbey 5838); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Shrub* 0.4–0.7 m tall, 0.5–1.8 m wide; flowering branchlets with 1–4 pairs of flowers, when more than one pair then these often at distant nodes. *Leaves* densely clustered and somewhat spreading on young branchlets, absent or more appressed on older branchlets. *Petioles* 0.1–0.2 mm long. *Leaf blades* ± narrowly oblong to narrowly ovate, 2–2.8 mm long, 0.6–0.8 mm wide, 0.3–0.4 mm thick, obtuse, minutely fringed; adaxial surface shallowly concave to flat; abaxial surface somewhat angled, with a flat portion along the midrib and sloping sides, the sides each with 1 row of usually 4–6 large oil glands. *Bracteoles* 0.8–1.4 mm long, with a minutely fringed margin. *Pedicels* 1.5–2.3 mm long. *Flowers* 7–8 mm diam. *Hypanthium* c. 1.3 mm long, c. 2.3 mm diam.; free part c. 1 mm long, inconspicuously 10-veined. *Sepals* depressed-ovate, c. 0.6 mm long, 1.1–1.4 mm wide, minutely fringed, with a few very large oil glands. *Petals* c. 2.5 mm long, white. *Antipetalous filaments* 1.2–1.4 mm long, 0.4–0.6 mm wide. *Antisepalous filaments* 0.6–0.8 mm long, 0.3–0.4 mm wide. *Anthers* 0.3–0.4 mm long. *Ovules* 3–5 per loculus. *Style* 2–2.7 mm long; stigma 0.1–0.2 mm diam. *Fruits* not seen at maturity but at least 2.3 mm long and 2 mm diam.

*Diagnostic features.* Distinguished from other members of sect. *Mesostemon* by the combination of ciliolate leaves 0.3–0.4 mm thick, antipetalous filaments 1.2–1.4 mm × 0.4–0.6 mm, and style 2–2.7 mm long.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 10 Sep. 1979, *K.R. Newbey* 5838 (PERTH); 8 Sep. 2005, *Peter G. Wilson* 1669 & *G.M. Towler* (NSW, PERTH).

*Distribution and habitat.* Extends from between Bullfinch and Southern Cross to c. 40 km south-west of Southern Cross, in south-western Australia (Figure 4A), recorded from sandy soil in mallee shrubland or woodland, also with one record from ‘clay soil with quartz pieces’.

*Phenology.* Flowers recorded in September.

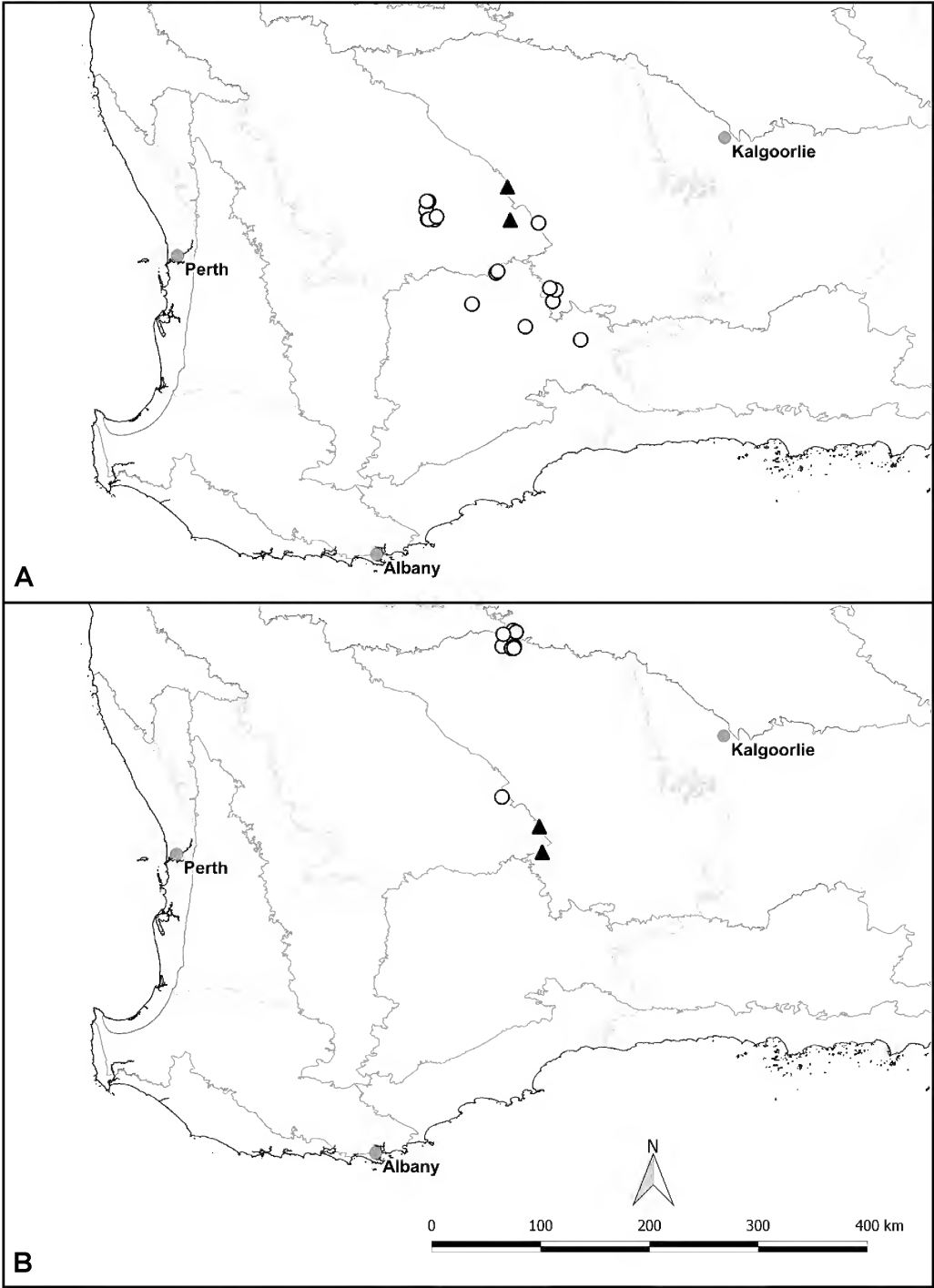


Figure 4. Distributions of new species of *Rinzia*. A—*R. fimbriolata* (▲) and *R. torquata* (○); B—*R. medifila* (▲) and *R. triplex* (○).

*Conservation status.* Listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015) under the name *Baeckea* sp. Bullfinch (*K.R. Newbey* 5838). Known from at least four localities, extending over a distance of at least 50 km.

*Etymology.* The epithet alludes to the minutely fringed margins of the leaves, bracteoles and sepals.

*Common name.* Wheatbelt Rinzia.

*Notes.* *Rinzia fimbriolata* was previously (in Trudgen 1986a) confused with *R. rubra* Trudgen of sect. *Rinzia*. *Rinzia rubra* is similar to all members of sect. *Mesostemon* in its non-arillate or scarcely arillate seeds, and its range is further inland than normal for sect. *Rinzia*. However, it tends to be a lower plant and differs in its broader filaments with a 2-lobed summit and the anther attached against the front surface.

The above description of *R. fimbriolata* is based on examination of the type, the selected specimens cited above and three collections by Brian Moyle (*B. Moyle* 26–28). The Moyle specimens, which include a DNA voucher specimen (*B. Moyle* 26), are currently in the private collection of Malcolm Trudgen despite a request for them to be housed at PERTH (*B. Moyle* pers. comm.). Collections with mature fruits are still needed for *R. fimbriolata*; the largest fruits seen (on *B. Moyle* 27), were about 2.3 mm long and 2 mm wide, with a style 2 mm long.

## 6. *Rinzia medifila* Rye & Trudgen, *sp. nov.*

*Typus:* Parker Range, Western Australia [precise locality withheld for conservation reasons], 11 October 1994, *N. Gibson & M. Lyons* 2270 (*holo:* PERTH 05359325; *iso:* CANB, K, MEL).

*Euryomyrtus ciliata* Trudgen ms; G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 386 (2000); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Euryomyrtus* sp. Parker Range (*N. Gibson & M. Lyons* 2269); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Shrub* up to 1 m tall, width not recorded; flowering branchlets with 1 or rarely 2 pairs of flowers. *Leaves* densely clustered and somewhat spreading on young branchlets, absent or more appressed on older branchlets. *Petioles* 0.2–0.4 mm long. *Leaf blades* ± oblong-elliptic, 1.8–3 mm long, 0.6–1.2 mm wide, up to 0.4 mm thick, obtuse, ciliolate; adaxial surface shallowly concave to flat; abaxial surface somewhat angled, with a flat portion along the midrib and sloping sides, the sides each with a row of usually 4–7 large oil glands. *Bracteoles* 1.1–1.5 mm long, minutely denticulate to ciliolate. *Pedicels* 0.8–1.3 mm long. *Flowers* 6–7 mm diam. *Hypanthium* 1.4–1.7 mm long, 2.5–3 mm diam.; free portion 0.6–0.8 mm long, 10-veined. *Sepals* depressed-ovate or depressed-elliptic, 0.5–0.6 mm long, 1.2–1.4 mm wide, denticulate or ciliolate, with a few very large oil glands. *Petals* 2–2.3 mm long, pale pink outside or apparently white throughout. *Antipetalous filaments* 0.6–0.8 mm long, 0.25–0.35 mm wide. *Antisepalous filaments* c. 0.5 mm long, 0.15–0.2 mm wide. *Anthers* 0.3–0.4 mm long. *Ovules* 3–5 per loculus. *Style* 1.2–1.8 mm long; stigma c. 0.2 mm diam. *Fruits* 1.7–2.3 mm long, 1.6–2 mm diam. *Seeds* not seen fully mature, 1.3–1.4 mm long, 0.6–0.7 mm wide, c. 0.5 mm thick; testa medium brown. (Figure 5)

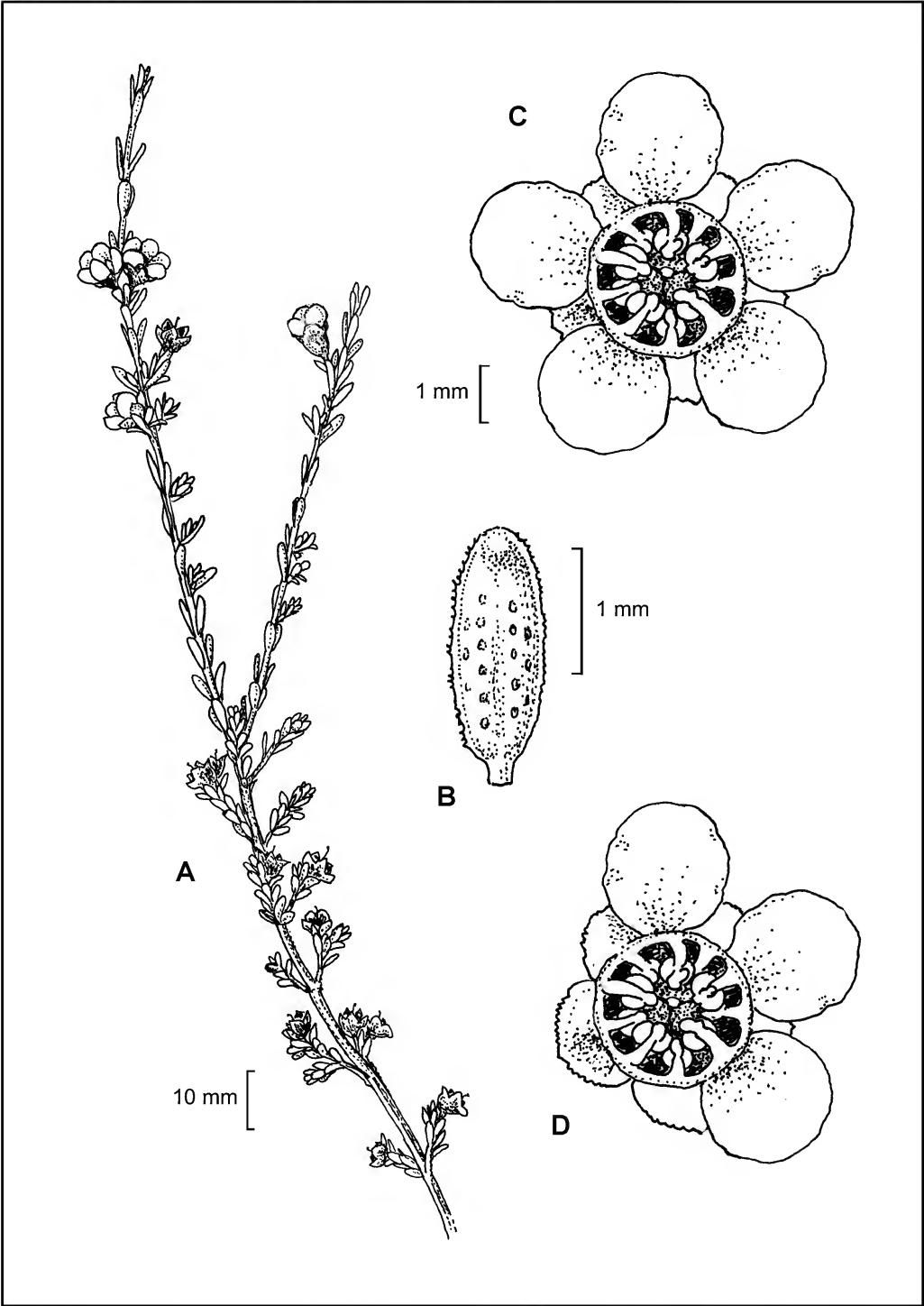


Figure 5. *Rinzia medifila*. A – flowering and fruiting branch; B – leaf; C – top view of flower; D – flower with two petals removed to show sepals. Drawn by M. Pieroni from N. Gibson & M. Lyons 2037.

*Diagnostic features.* Within sect. *Mesostemon* this species has the flattest leaves, smallest antipetalous filaments, which are 0.6–0.8 mm long and also tend to be narrower than in the other two species, and the shortest style, which is 1.2–1.8 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 17 Oct. 1994, N. Gibson & M. Lyons 2037 (AD, BRI, NSW, PERTH); 11 Oct. 1994, N. Gibson & M. Lyons 2269 (PERTH).

*Distribution and habitat.* Known only from Parker Range, south-east of Southern Cross (Figure 4B). Recorded in yellowish or reddish sandy soils, sometimes with laterite or greenstone, in *Eucalyptus* woodlands, often with *Melaleuca*.

*Phenology.* Flowers at least from September to October.

*Conservation status.* Listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015) under the name *Euryomyrtus* sp. Parker Range (N. Gibson & M. Lyons 2269). Known from two or three localities, with a range c. 35 km long.

*Etymology.* From the Latin *medius* (middle, intermediate) and *fila* (threads), as this species has filaments of medium width for the genus, which was part of the reason it was mistaken for a species of *Euryomyrtus*.

*Common name.* Parker Range Rinzia.

*Notes.* This species is poorly known, with the description based on only three specimens. It was previously misplaced in *Euryomyrtus*, initially as *E. ciliata* Trudgen ms and later as *E. sp.* Parker Range. *Euryomyrtus* differs from *Rinzia s. lat.* in having parallel venation on the adaxial surface of the leaves and floral colleters that are connate into obvious antipetalous groups. *Rinzia medifila* is actually most similar to *R. fimbriolata*, but has more flattened leaves that are less obviously ciliate, smaller stamens and a shorter style. It also tends to have shorter pedicels although its peduncles may be slightly better developed.

**Rinzia** sect. **Polyandra** Rye & Trudgen, *sect. nov.*

*Typus:* *Rinzia polystemonea* (F.Muell.) Rye.

‘*Aethestemon*’ ms, in B.L. Rye, *Nuytsia* 19: 320 (2009).

‘*Xeromesos*’ ms, in B.L. Rye, *Nuytsia* 19: 320 (2009).

Erect *shrubs* up to 2.5 m tall. *Leaf blades* concolorous, with crowded oil glands. *Peduncles* less than 0.5 mm long, 1-flowered. *Bracteoles* caducous to persistent,  $\pm$  entire. *Pedicels* 1–6 mm long. *Petals* white to bright pink. *Staminodes* (when present) 5–21, in antisepalous groups of 1–5, with a reduced filament or sessile and all or mostly with an obvious connective gland, those closest to centre of sepals shortest. *Stamens* 15–24, fairly uniformly spaced when 20 or more are present, but with antipetalous triads separated by broad spaces if antisepalous stamens are reduced to staminodes. *Filaments* free,  $\pm$  terete, less than 0.25 mm wide; apex below top of anther. *Anthers* versatile. *Ovary* c. 1/2-inferior;

ovules 2–5 per loculus, collateral or in an arch. *Style* 0.9–2.5 mm long; stigma peltate. *Fruits* erect, just over 1/2- to 3/4-superior. *Seeds* broadest towards the apex, 1.6–2.1 mm long, brown, tuberculate; inner surface either with a central longitudinal ridge or with a circular rim, without an aril.

*Diagnostic features.* This section has the greatest shrub size recorded (up to 2.5 m high) in the genus, the broadest stigma, and on average the highest stamen numbers (15–24), sometimes combined with 5–21 staminodes. Other important characters are: stamens with a narrow filament; seeds borne on blackish placentas, tuberculate, and non-arillate.

*Distribution and phenology.* Two species occur in the central inland part of the South West Botanical Province and the adjacent part of the Eremaean Botanical Province of Western Australia and one in central Australia, in the far inland part of Western Australia and southern Northern Territory (Figure 3). Flowering is seasonal in the two south-western species but more opportunistic in the arid-zone species.

*Etymology.* From the Greek *poly-* (many-) and *-andrus* (-stamen), referring to the large numbers of stamens and sometimes staminodes.

*Notes.* This section has a large disjunction between the south-western and central Australian areas. The two south-western species differ from all other members of the genus in having staminodes and this distinctive group within sect. *Polyandra* was apparently collected for the first time in 1966, with the second species not collected until 1997. Had early taxonomists been aware of these two species, they might well have placed them in a separate genus or section in view of their unique staminodes, mostly with a full-sized connective gland. Where there are only two staminodes separating the triads of stamens, each staminode may be close to the margin of a group of stamens and separated by a distinct gap from the other staminode. Where there are more numerous staminodes, these are usually spaced fairly uniformly between stamen groups so there is no obvious disjunction between them. The filament is reduced to a short stalk or rarely absent. The function of the glandular staminodes needs investigation.

Although the central Australian species *R. polystemonea* has no staminodes, it does have short stamens in the positions where the staminodes occur in the south-western species, and the similarities it shows seem of more importance than the differences. All three species have an erect habit, leaves with crowded oil glands, a peltate stigma and placentas that become blackish as the seeds mature. While the seed-bearing placentas are almost black, the infertile placentas are much paler, sometimes white as illustrated in Figure 1G.

There are both similarities and differences in the seeds of the south-western and central Australian species. All species have large seeds with a tuberculate testa and no aril. However, the centre of the inner surface of the seed has a longitudinal ridge in *R. polystemonea* (Figure 6E) whereas the two south-western species lack the ridge and instead have a distinctive, large, circular rim (Figure 1H).

## 7. *Rinzia polystemonea* (F.Muell.) Rye, *comb. nov.*

*Baeckea polystemonea* F.Muell., *Fragm.* 2: 124 (1861). *Type*: Brinkley's Bluff, Macdonnell Ranges, Northern Territory, 1860, J. McDouall-Stuart s.n. (*holo*: MEL 72914).

*Shrub* 0.5–2.5 m tall, erect to straggly or rarely low and spreading; flowering branchlets usually with 1–5 pairs of flowers. *Leaves* appressed or antrorse, often crowded. *Petioles* 0.2–0.5 mm long. *Leaf*

*blades* usually  $\pm$  narrowly oblong to linear, 3–7 mm long, 0.7–1.3 mm wide, either  $\pm$  flat or up to 0.5 mm thick, obtuse, entire; adaxial surface concave or channeled or fairly flat; abaxial surface convex with or without steep sides, or flattened on top and channeled, with oil glands in 2–4 main rows on each side of midvein. *Bracteoles* caducous to persistent, linear to ovate, 0.8–2.5 mm long, scarious. *Pedicels* 1.5–6 mm long. *Flowers* 7.5–10.5 mm diam. *Hypanthium* 1.7–3.1 mm long, 2.6–4.1 mm diam.; free part 0.8–1.1 mm long. *Sepals* depressed-ovate, 1–1.6 mm long, 1.6–2.6 mm wide, entire. *Petals* 2.7–3.7 mm long, pink or white. *Stamens* 17–24, with a triad opposite each petal and 0–2 small ones spaced between each triad. *Antipetalous filaments* 1.2–1.7 mm long. *Antisepalous filaments* 0.3–0.5 mm long. *Anthers* 0.3–0.5 mm long; connective gland 0.1–0.2 mm long. *Ovules* 2–5 per loculus, most commonly 4 or 5. *Style* 1.7–2.5 mm long; stigma 0.3–0.5 mm diam. *Fruits* with petals and stamens usually persistent, 3/5–3/4-superior, 2–2.7 mm long, 2.5–3 mm diam. *Seeds* 1.6–2.1 mm long, 0.7–0.8 mm wide, 0.7–0.8 mm thick; inner surface with a central longitudinal ridge. (Figure 6)

*Diagnostic features.* Distinguished from the two other species of sect. *Polyandra* by its more numerous stamens, the absence of staminodes, and by its seeds having a central longitudinal ridge on the inner surface rather than a circular structure.

*Selected specimens examined.* WESTERN AUSTRALIA: near Glen Helen, Rawlinson Range, 20 July 1967, A.S. George 8810 (PERTH); SE end of Rawlinson Range, 29 July 2000, P.M. Olde, N. Marriott & C. Crouch PMO 2000/298 (NSW, PERTH); Pingkalpiri (Bunggalbiri) Rockhole, Walter James Range, 26 June 1989, D.J. Pearson DJP 644 (PERTH). NORTHERN TERRITORY: Penny Springs, George Gill Range, 14 July 1968, A.C. Beauglehole 26767 (NT); Palm Valley, 25 Aug. 1956, G. Chippendale 2676 (AD, BRI, CANB, MEL, NSW, NT, PERTH); Kings Canyon, 10 Dec. 1968, P.K. Latz 278 (CANB, NSW, NT); Spencer Gorge, Chewing Range, 26 May 1977, P.K. Latz 7112 (BRI, CANB, K, MEL, NT, PERTH); Standley Chasm area, 8 Aug. 1976, J.R. Maconochie 453 (DNA, NT).

*Distribution and habitat.* Extends from Rawlinson Range in Western Australia east at least to the Macdonnell Ranges of Northern Territory, recorded on rocky slopes and cliff edges of quartzite, metaquartzite and sandstone, often near creeks or gorges, in skeletal soil, red sand and rocky soil. Also recorded in hummock grassland with *Acacia*, mallee and *Grevillea* species. *Rinzia polystemonea* occupies the central Australian part of the distribution shown for sect. *Polyandra* in Figure 3.

*Phenology.* Flowering collections have been made throughout the year. Flowering and fruiting probably occur at any time of the year, stimulated by irregular rainfall.

*Conservation status.* This species is known from numerous localities over an extensive range, and is not considered to be at risk.

*Etymology.* From the Greek *poly-* (many-) and *-stemon* (-stamened). A maximum of 24 stamens per flower has been recorded so far for this species; the highest number known in the remainder of the genus is 20.

*Common name.* Desert Rock-myrtle.

*Notes.* *Rinzia polystemonea* is geographically disjunct from all other members of the genus. It is the tallest member of the genus and has, on average, the largest number of stamens and the largest stigma. Molecular data discussed earlier strongly support this species as sister to the clade containing *R. torquata* and *R. triplex* Rye & Trudgen.

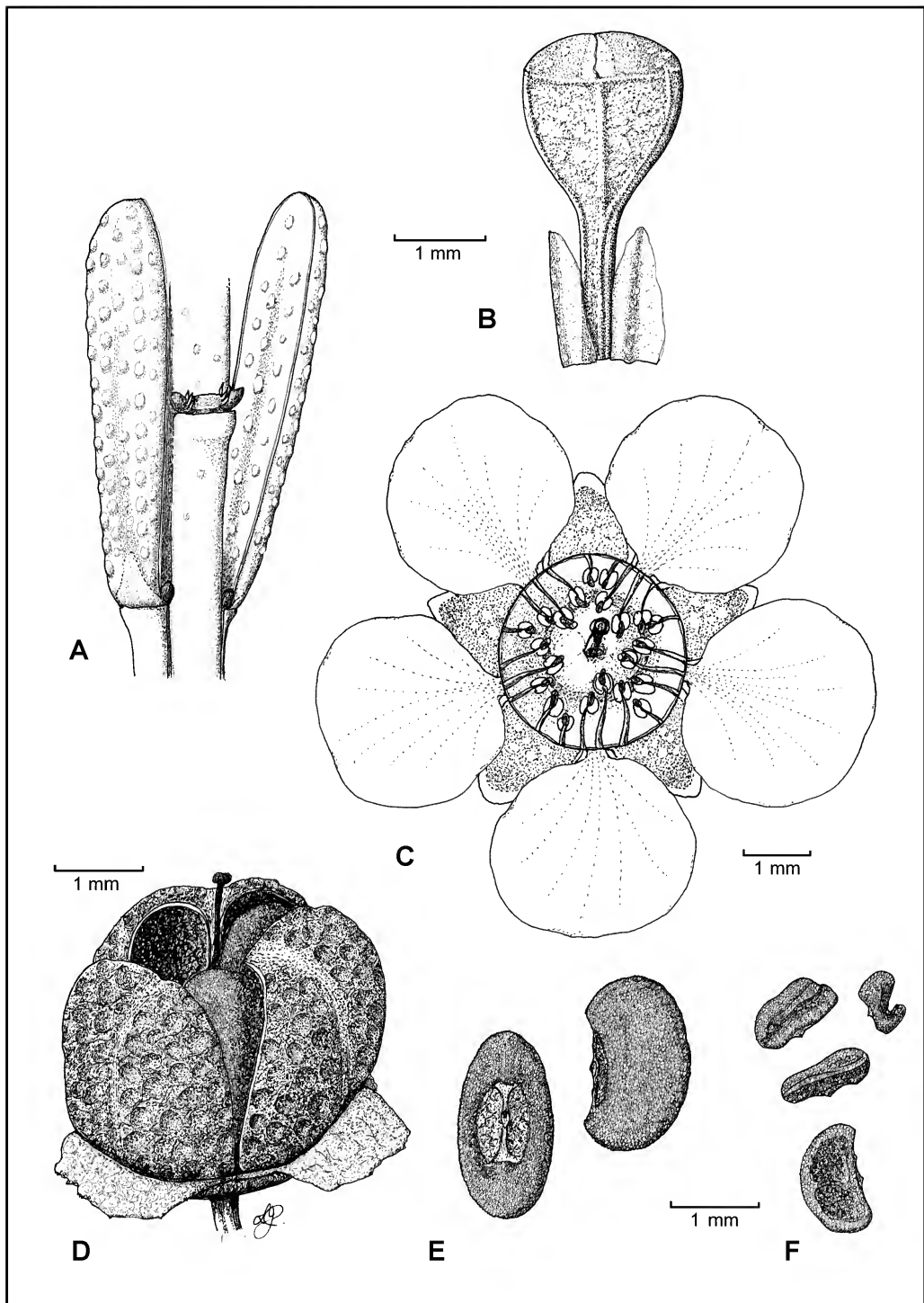


Figure 6. *Rinzia polystemonea*. A – opposite leaves; B – bracteoles, pedicel and flower bud; C – flower; D – fruit; E – inner and side views of seed; F – chaff. Drawn by L. Cobb from A.S. George 8810 (A–C) and A.S. George 8279 (D–F).

Where crowded on short branchlets, the leaves are usually obviously 4-ranked. Young leaves are occasionally slightly thicker than wide, but older leaves are wider than thick, often much wider.

Many specimens have relatively mature, unopened fruits, but very few have dehiscent fruits attached. It appears from the few dehiscent fruits examined that they do not open as widely as in other species, but a bigger sample of fruits is needed to confirm this. The petals tend to persist on young fruits.

### 8. *Rinzia torquata* Rye & Trudgen, *sp. nov.*

*Typus*: Hyden [area], Western Australia [precise locality withheld for conservation reasons], 10 August 2000, *J.M. Flint* 173 (*holo*: PERTH 05751926; *iso*: CANB, MEL).

*Baeckea* sp. Merredin (K.R. Newbey 2506); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Shrub* 0.5–1.7 m tall, up to at least 0.5 m wide, often multi-branched from ground level; flowering branchlets with usually 1 pair of flowers, but sometimes with 2 separated pairs. *Leaves* appressed to somewhat spreading, often crowded on the young branchlets. *Petioles* 0.1–0.2 mm long. *Leaf blades* narrowly obovate to oblong-elliptic in outline, 1.4–2.5 mm long, 0.8–1.2 mm wide, 0.4–0.8 mm thick, mostly distinctly wider than thick, obtuse, entire or rarely denticulate; adaxial surface shallowly concave to flat; abaxial surface flattened or convex between sloping sides that extend outwards, with oil glands in 2 or 3 main rows on each side of midrib. *Bracteoles* persistent, 1.1–1.7 mm long, largely herbaceous. *Pedicels* 1–4.5 mm long. *Flowers* 6.5–8.5 mm diam. *Hypanthium* 1.1–1.5 mm long, c. 2.5 mm diam.; free portion 0.5–0.7 mm long. *Sepals* very broadly ovate or depressed-ovate 1.0–1.3 mm long, 1.3–1.6 mm wide, entire or minutely denticulate. *Petals* 2.3–3 mm long, deep pink outside in bud, pink inside at first but becoming pale pink. *Antipetalous filaments* 0.8–1.3 mm long. *Anthers* 0.3–0.4 mm long. *Staminodes* 10–21, with 2–5 between each triad of stamens, when 2 then often with a large gap between them, when 4 then equidistant, mostly terminating in a broadly obovoid, red-brown or whitish (very pale brown) gland up to 0.4 mm long. *Ovules* 2(3) per loculus. *Style* 0.9–1.5 mm long; stigma 0.2–0.3 mm diam. *Fruits* c. 2.5 mm long, c. 2.5 mm diam.; fertile placentas very dark red-brown; immature or sterile placentas (when present) white or off-white. *Seeds* few per fruit, absent or 1 per loculus, 1.6–1.8 mm long, 1–1.2 mm wide, 1–1.2 mm thick; inner surface with a  $\pm$  circular rim surrounding a flat, whitish hilum 0.4–0.6 mm diam. (Figures 1, 7A)

*Diagnostic features*. Distinguished from other species of *Rinzia* in having 10–21 staminodes, the only other species with staminodes having 5–11 of them. Also distinguished from the other staminode-bearing species in having leaves 0.8–1.2 mm wide, mostly distinctly wider than thick, with oil glands in 2 or 3 irregular rows on each sloping side of midrib, and 2(3) ovules per loculus.

*Selected specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 24 Aug. 1994, *H.H. Adamson* s.n. (PERTH 05320291); 10 Sep. 1990, *B. & B. Backhouse* H37A (PERTH); 10 Sep. 1966, *M. Barrow* 106 (KP, PERTH); 20 June 2005, *G.F. Craig* 6508 (PERTH); 22 June 2005, *G.F. Craig* 6544 (PERTH); Oct. 2000, *J.M. Flint* 33 B (PERTH); 15 Sep. 1976, *B.C. Habeley* 361 (PERTH); 9 Aug. 1979, *K.R. Newbey* 5460 (PERTH); 15 Oct. 2003, *B.L. Rye* 231085 & *M.E. Trudgen* (AD, BRI, NSW, PERTH); 4 Nov. 2004, *B.L. Rye* 241129 & *M.E. Trudgen* (PERTH); 12 Aug. 2003, *Peter G. Wilson* 1664 & *G.M. Towler* (PERTH); 6 Aug. 1974, *E. Wittwer* W 1282 (KP, PERTH).

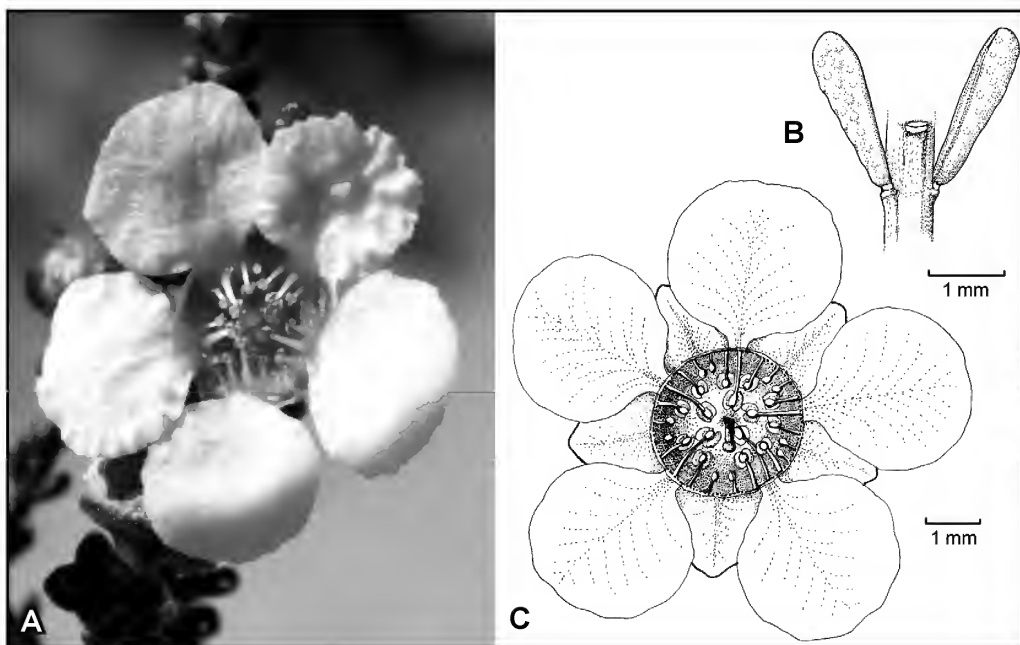


Figure 7. South-western Australian species of *Rinzia* sect. *Polyandra*. A—flower of *R. torquata*; B—opposite leaves of *R. triplex*; C—top view of flower of *R. triplex*. Image (A) taken by B.L. Rye (voucher B.L. Rye 231086 & M.E. Trudgen); drawings (B, C) by L. Cobb from M. Hislop 2968 & F. Hort.

**Distribution and habitat.** Extends from near Merredin east to Parker Range and south-east to near Hatter Hill (Figure 4A). Commonly occurs in yellow sand or lateritic habitats, sometimes with some clay, often in vegetation dominated by mallees, *Acacia*, *Allocasuarina* and *Melaleuca*.

**Phenology.** Flowers from July to October, with mature fruits recorded from October to early December.

**Conservation status.** Listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015) under the name *Baeckea* sp. Merredin (K.R. Newbey 2506). The known distribution is about 220 km long but the species does not appear to occur in any national parks.

**Etymology.** From the Latin *torquatus* (adorned with a necklace or collar) referring to the strings of staminodes linking the triads of stamens.

**Common name.** Necklace *Rinzia*.

**Notes.** This species is very similar to *R. triplex* but is distinguished as indicated by the diagnostic characters above; see also the notes under *R. triplex*. A somewhat isolated specimen from Parker Range, M.E. Trudgen 23352 A, differs from other specimens of both species in having minutely denticulate margins to its leaves.

Rather than having a complete circle of stamens and staminodes, some specimens, e.g. J.M. Flint 173, have the stamens and staminodes arranged mostly in five groups per flower, with a single staminode on each margin of the triad of stamens opposite each petal and a gap opposite each sepal.

### 9. *Rinzia triplex* Rye & Trudgen, *sp. nov.*

*Typus*: south of Moorine Rock, Western Australia [precise locality withheld for conservation reasons], 1 August 2003, M. Hislop & F. Hort MH 2968 (*holo*: PERTH 06465641; *iso*: CANB, MEL).

*Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Shrub* 0.3–1.5 m tall, up to at least 1.2 m wide; flowering branchlets with 1 pair of flowers or rarely 2 separated pairs. *Leaves* appressed to somewhat spreading, densely 4-ranked on the young branchlets. *Petioles* 0–0.15 mm long, poorly defined or absent. *Leaf blades* narrowly obovate to oblong-elliptic in outline, 1.5–2.2 mm long, 0.5–0.6 mm wide, 0.55–0.6 mm thick, obtuse, entire; adaxial surface shallowly concave to flat, when young often grooved along the centre; abaxial surface convex between ± vertical sides, with 4–6 very large oil glands in a main row on each side of midrib, with smaller glands often forming a second row. *Bracteoles* persistent, 1.2–2 mm long, largely herbaceous. *Pedicels* 2–3.5 mm long. *Flowers* 6–10 mm diam. *Hypanthium* 1.2–2 mm long, 2.5–3 mm diam.; free part 0.7–0.9 mm long. *Sepals* depressed-ovate, 1.5–1.6 mm long, 1.5–2 mm wide, entire. *Petals* 2.3–3.5 mm long, bright pink at first, becoming paler with age. *Antipetalous filaments* 0.9–1.3 mm long, bright pink. *Anthers* 0.3–0.4 mm long. *Staminodes* 5–11, 1 or 2(3) between each triad of stamens, often with a large gap between them, when 3 the central one shortest, mostly terminating in an obovoid, brown or pinkish gland, up to 0.5 mm long. *Ovules* 3(4) per loculus. *Style* 1.2–1.6 mm long; stigma 0.25–0.35 mm diam. *Fruits* not seen at maturity but *c.* 2/3-superior. *Seeds* not seen at maturity; inner surface with a circular cavity surrounding a flat, whitish hilum. (Figure 7B, C)

*Diagnostic features.* Distinguished from other members of the genus in having 5–11 staminodes, the only other species with staminodes having 10–21 of them. Distinguished from the other staminode-bearing species in having leaves 0.5–0.6 mm wide, about as thick as wide, with oil glands mainly in a single irregular row on each more or less vertical side of midrib and 3(4) ovules per loculus.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 27 Aug. 1997, G. Flowers 66 & S. Donaldson (PERTH); 7 Aug. 2007, A. Markey & S. Dillon 5210 (PERTH); 23 Feb. 2005, S. McNee & G. O'Keefe LCH 12206 (PERTH); 1 Sep. 2010, S. Reiffer SRE 288 (PERTH).

*Distribution and habitat.* Extends from the Die Hardy Range area (north of Koolyanobbing), south to the Southern Cross area (Figure 4B). Recorded on sandy plains in yellow to red, often gravelly or lateritic soils, with one record mentioning fragments of banded ironstone, dominated by *Acacia*, *Eucalyptus* or *Allocasuarina*, often with *Baeckea elderiana* present. *Rinzia triplex* is often a significant component of the shrublands at these sites.

*Phenology.* Flowers recorded late June to September.

*Conservation status.* Listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015) under the name *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968). The distribution of *R. triplex* is at least 230 km long.

*Etymology.* The epithet is Latin and refers to both the stamens and ovules, which are usually in groups of three (triads).

*Common name.* Triad *Rinzia*.

*Notes.* This species is very similar to *R. torquata*, but differs as indicated in the diagnostic characters and mainly occurs north of the range of *R. torquata*. The phrase name *Baeckea* sp. Parker Range was an inappropriate choice for *R. triplex* as *R. torquata* has been recorded from Parker Range but *R. triplex* does not extend so far south. *Rinzia triplex* often has five or ten fairly obvious ribs on the hypanthium and there are sometimes inconspicuous ribs on *R. torquata*, but this character may not be reliable in distinguishing the two taxa.

Mature seeds of *R. triplex* have not been seen, but the largest of the immature seeds examined appears to match the seeds of *R. torquata*. At least one flower of *R. triplex* was observed to have 16 rather than the usual 15 stamens, with one of the triads replaced by four stamens. Antipetalous colleters are often relatively conspicuous (up to 0.8 mm long) in this species.

### ***Rinzia* Schauer sect. *Rinzia***

Prostrate or low, spreading *shrubs*. *Leafblades* plano-convex or concavo-convex, concolorous, without an apical point. *Peduncles* 1- or 2-flowered. *Bracteoles* persistent, usually  $\pm$  entire. *Pedicels* 0.8–6.5 mm long. *Petals* white to bright pink. *Stamens* (5–)10, opposite all the sepals and petals or (when less than 10) all or mostly antipetalous, connate at base. *Antipetalous filaments* flattened, 0.5–1.2 mm wide; apex usually reaching to far exceeding top of anther, often emarginate to 2-horned, distinctly papillate in most species. *Anthers* attached at front of filament, not versatile. *Ovary* largely superior to c. 1/2-inferior; ovules either 2 per loculus and collateral or 3–9 and in an arch or 2 rows. *Style* 0.6–2.5 mm long; stigma small, capitate or scarcely expanded. *Fruits* tending to be pendulous, largely superior. *Seeds* 1.3–2 mm long, smooth to shortly tuberculate, becoming dark brown to black at maturity; inner surface with a large whitish aril (absent or vestigial in *R. rubra*).

*Diagnostic features.* Distinguished from all other sections of *Rinzia* by the following combination of characters: concolorous leaves; stamens usually 10 opposite sepals and petals, rarely 5–9 and all or mostly antipetalous; filaments compressed, scarcely to markedly connate; seeds with an obvious aril (rudimentary to absent in one species).

*Distribution and phenology.* Fairly widespread in the South West Botanical Province of Western Australia (Figure 2B), with seven species restricted to this province and one, *R. sessilis*, extending into the Eremaean. The eight species of sect. *Rinzia* tend to have long flowering periods and several pairs of species overlap in range.

*Notes.* In a number of morphological characters, sect. *Rinzia* is the most varied section, for example in having ovule numbers ranging from two to nine per loculus. It appears that some species can regenerate after fire; for example, one specimen (*B.R. Maslin* 3859) of *R. affinis* has more than 20 slender stems arising from a thick base and a specimen of *R. crassifolia* (*B. Hort* 2669) is recorded as being multi-stemmed from a lignotuber.

**10. *Rinzia affinis*** Trudgen, *Nuytsia* 5: 431–432 (1986). *Type*: 14 km W of Newdegate, Western Australia, 12 August 1968, *Paul G. Wilson* 7032 (*holo*: PERTH 00999806; *iso*: CANB 367220, K 000821694, NSW 542229).

*Illustrations.* Drawings on *C.A. Gardner* 1770 (PERTH); M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, top row on left (1986).

*Shrub* 0.1–0.7 m high. *Petioles* 0.2–0.5 mm long. *Leaf blades* usually narrowly oblong in outline, 2.5–5 mm long, 0.7–1 mm wide, *c.* 0.5 mm thick, obtuse to acute, entire. *Peduncles* 2-flowered; secondary axes  $\pm$  absent. *Bracteoles* 1.5–2.3 mm long. *Pedicels* 2–4 mm long. *Flowers* 8–11 mm diam. *Hypanthium* 1.3–2 mm long. *Sepals* 1–2.3 mm long. *Petals* 3–4.5 mm long, white or pale pink. *Stamens* 10, shortly connate. *Antipetalous filaments* 1.2–1.8 mm long, 0.6–0.9 mm wide. *Antisepalous filaments* 0.8–1.1 mm long, 0.3–0.5 mm wide. *Anthers* 0.3–0.5 mm long. *Ovules* 3–5 per loculus. *Style* 1.3–1.5 mm long. *Fruits* 2–2.3 mm long. *Seeds* 1.4–1.6 mm long, 0.5–0.55 mm wide, 0.7–0.8 mm thick, smooth, with an aril 0.8–1 mm long, extending to top end of seed.

*Diagnostic features.* Distinguished from all members of the genus except *R. dimorphandra* by the following combination of characters: peduncles 2-flowered; ovules 3–5 per loculus; seeds smooth, arillate. Distinguished from *R. dimorphandra* by minor characters including its usually paler petals.

*Selected specimens examined.* WESTERN AUSTRALIA: 1 km W of wheat bin, Tarin Rock railway line, 14 Oct. 2002, *E. Bishop* 130 (PERTH); Lake Magenta Nature Reserve, East Rd, 28 Sep. 2004, *A. Coates* 4834 *et al.* (AD, PERTH); S side of Siberia Rd, 5 km SE of Kukerin, 13 Sep. 2002, *J. Gray* 8 (PERTH); DoYLES Rd E of Geetabin Rd, Corrigin, 26 Sep. 1995, *M. Osborne* 362 (PERTH); adjacent to Old Newdegate Rd, N of Dunn Rock Nature Reserve, 30 Aug. 2006, *S. Walsh* 92 (PERTH); 7 km E of Tarco Rd, Lake King Nature Reserve, 28 Aug. 2002, *G. Woodman & C. Godden* FR 0208-24 (PERTH).

*Distribution and habitat.* Extends from near Harrismith east to Lake King, in sandy soils often over laterite, in species-rich heathlands. *Rinzia affinis* overlaps in range with several other members of sect. *Rinzia* and appears to hybridise with *R. communis* (see notes under that species below).

*Phenology.* Flowers from July to November, with mature fruits recorded in October and November.

*Conservation status.* Listed by Jones (2015) as Priority Four under Department of Parks and Wildlife Conservation Codes for Western Australian Flora. Although *R. affinis* has a much greater geographic range than several other *Rinzia* species that are not currently listed, such as *R. oxycoccoides*, and is known from at least three conservation reserves, its conservation status has been retained because the size and status of the majority of populations are unknown.

*Etymology.* The epithet is Latin and refers to its close similarity to *R. dimorphandra*, within which it was previously included.

*Common name.* Two-flowered *Rinzia*.

*Notes.* This species is closely related to *R. dimorphandra*, with both taxa having 2-flowered peduncles and narrow seeds (see Trudgen 1986a: Figure 2), but the sepals in *R. affinis* have a more obvious border, the petals are usually paler, and the leaves show a greater tendency to overlap those of the node above. The two taxa are geographically disjunct, with *R. affinis* occurring *c.* 150 km west of the range of *R. dimorphandra*.

Trudgen (1986a) also considered that the two taxa differ in their habitat, and separated them in his key using differences in fruit (smooth and chartaceous in *R. affinis* vs minutely pitted and fairly thick-walled in *R. dimorphandra*), seed length (1.4–1.5 mm vs 1.1–1.3 mm respectively) and aril shape (reaching the seed apex in *R. affinis* but not in *R. dimorphandra*). However, my seed measurements disagree, with similar measurements for *R. dimorphandra* and *R. affinis*, suggesting that previously

there had been few seeds available to measure and possibly not all of them mature. While all seeds examined of *R. affinis* had the aril reaching the apex, those of *R. dimorphandra* varied from having a shorter, fairly central aril, to a longer aril that reached the top of the seed. There also did not appear to be any difference in the fruit wall of the two taxa, but some difference in their habitat is likely since they are geographically separated.

One difference between the two species that has not been pointed out previously is that *R. affinis* has a minimum of three ovules per loculus whereas *R. dimorphandra* has a maximum of three ovules per loculus; this difference was hidden by the inaccurate ovule numbers (3–5 rather than 2 or 3) given for *R. dimorphandra* by Trudgen (1986a). All flowers of *R. affinis* examined in the current study had a maximum of five ovules per loculus, although up to seven ovules were recorded by Trudgen (1986a).

**11. *Rinzia communis*** Trudgen, *Nuytsia* 5: 435–436 (1986). *Type*: Mt Madden, south-east of Lake King, Western Australia, 29 July 1976, M.E. Trudgen 1700 (*holo*: PERTH 01631829; *iso*: CANB 367223, K 000821697, MEL 1552707, NSW 542177).

*Illustrations*. Drawings on C.A. Gardner s.n. Nov. 1931 (PERTH 05849128); M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, top row on right (1986).

*Shrub* usually 0.1–0.3(–0.5) m high but rarely up to 1 m high, 0.2–1.2 m wide. *Petioles* 0.2–0.4 mm long. *Leaf blades* narrowly ovate to linear in outline, (1.5–)2–5.5 mm long, 0.4–0.8 mm wide, 0.5–0.9 mm thick, obtuse, entire. *Peduncles* 1-flowered. *Bracteoles* 0.7–1.4 mm long. *Pedicels* (1.5–)2–4(–5) mm long. *Flowers* 6–9.5 mm diam. *Hypanthium* 0.7–1 mm long. *Sepals* 0.7–1.2 mm long. *Petals* 2.5–4.5 mm long, white or pale pink. *Stamens* 10, connate for up to c. 0.8 mm. *Antipetalous filaments* 1.4–2.2 mm long, 0.6–1 mm wide. *Antisepalous filaments* 0.9–1.6 mm long, 0.3–0.6 mm wide. *Anthers* c. 0.4 mm long. *Ovules* 2 per loculus. *Style* 1.3–1.8 mm long. *Fruits* 1.6–2.3 mm long. *Seeds* 1.3–1.7 mm long, 0.6–0.7 mm wide, 0.8–1 mm thick, colliculate; aril central on inner surface, 0.6–1 mm long.

*Diagnostic features*. Distinguished from other members of sect. *Rinzia* by the following combination of characters: leaves petiolate, very thick; ovules 2 per loculus; seeds colliculate.

*Selected specimens examined*. WESTERNAUSTRALIA: Dam 541, S side of Newdegate–Lake King Rd, 22 Nov. 2006, A. Coates AC 5743 (PERTH); Lake King Nature Reserve, 16 Aug. 1995, M.S. Graham MSG 505 (PERTH); N side of track, 9.3 km NW of Mallee Rd junction, Dunn Rock Nature Reserve, 13 May 1999, G.J. Keighery & N. Gibson 3003 (PERTH); 30.3 km E of Lake Grace on road to Lake King, 18 Sep. 2007, B.L. Rye 279032 (PERTH); junction of Rollands Rd and Cascades Rd, NW of Esperance, 22 Oct. 1997, Peter G. Wilson 1425 & N. Lam (NSW, PERTH).

*Distribution and habitat*. Extends from Gnowangerup east to the Young River area and north-east to Frank Hann National Park, in varied soil types associated with hills or on plains, often in mallee vegetation. *Rinzia communis* overlaps in range with *R. affinis* and *R. sessilis* and extends to the edge of the ranges of *R. fumana* and *R. rubra*.

*Phenology*. Flowers and fruits from June to November.

*Conservation status*. This is the most commonly collected species of *Rinzia* in south-western Australia, and is not considered to be at risk.

*Etymology.* The epithet is Latin and means common; Trudgen (1986a: 436) considered this species to be ‘the most widespread and common species in the genus’. However, the Western Australian species *R. carnosa* is now known to have a greater range, and in the expanded genus, *R. orientalis* is the most widespread and commonly collected species.

*Common name.* Mallee Rinzia.

*Notes.* This species has been confused with *R. fumana* but differs in having its leaves furrowed on the abaxial surface, and in the filament characters used in the key. Most specimens of *R. fumana* also differ from *R. communis* in having a smooth, glossy coating on the seeds.

The specimen *Peter G. Wilson* 1437 & *E.A. Brown* appears to be a hybrid between *R. communis* and *R. affinis*. The putative hybrid has leaves of intermediate morphology; it matches *R. communis* in having 1-flowered peduncles and broad seeds, but the seeds are smooth as in *R. affinis* and there are three ovules per loculus, which means that it keys out with *R. affinis*. Another specimen may be a hybrid between *R. communis* and *R. sessilis* (see notes under the latter species).

Many specimens have short leaves densely 4-ranked on their branchlets but some, including those associated with granite outcrops, tend to have longer leaves that are not obviously 4-ranked.

An atypical variant from the Lake King area is known from ten specimens, three of which are cited above (*A. Coates* AC 5743; *M.S. Graham* MSG 505; *G.J. Keighery* & *N. Gibson* 3003). It has leaves that are abaxially grooved rather than convex as in the typical variant. It might also tend to have longer petioles and seeds than usual, but seed measurements are known only from one specimen.

**12. *Rinzia crassifolia*** Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersbourg* 10: 331 (1852). *Type:* south-western Australia [Toodyay to Mullean area and to south coast], Western Australia, 1847–1849, *J. Drummond* coll. 5: 122 (*holo:* KW 001001295; *iso:* BM 001015090, K 000843242, MEL 76343, PERTH 01631845 & 01829505).

*Baeckea platystemona* Benth., *Fl. Austral.* 3: 74 (1867). *Hypocalymma platystemon* (Benth.) Nied., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3(7): 99 (1893). *Type:* south-western Australia, 1847–1849, *J. Drummond* coll. 5: 122 (*lecto:* K 000843242, *fide* M.E. Trudgen, *Nyctisia* 5: 437 (1986); *isolecto:* BM 001015090, KW 001001295, MEL 76343, PERTH 01631845 & 01829505; south-western Australia [north of Moore River to King George Sound and West Mt Barren, Western Australia], 1844 or 1846–1847, *J. Drummond* coll. 4: 148 (*syn:* MEL 73910, PERTH 01631837).

*Rinzia* sp. Darling Range (F. Hort 2040); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 5 January 2016].

*Illustrations.* W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 68 (1980) [as *Baeckea platystemona*]; M.E. Trudgen, *Nyctisia* 5: 419, Figure 2, bottom row on left (1986).

*Shrub* usually 0.1–0.3 m high, scrambling or prostrate. *Petioles* 0.2–0.4 mm long. *Leafblades* elliptic to linear in outline, 2–12 mm long, 0.5–1.8 mm wide, 0.2–0.7 mm thick, obtuse or acute, entire. *Peduncles* 1(2)-flowered. *Bracteoles* 1.6–3.8 mm long. *Pedicels* (2.5–)4–9 mm long. *Flowers* 7.5–13 mm diam. *Hypanthium* 0.7–1.5 mm long. *Sepals* 1.3–2.3 mm long. *Petals* 3–5 mm long, white to bright pink. *Stamens* 10, connate for 0.3–0.7 mm. *Antipetalous filaments* 1.2–2.2 mm long, 0.6–1.2 mm wide.

*Antisepalous filaments* 0.9–1.4 mm long, 0.3–0.6 mm wide. *Anthers* 0.35–0.5 mm long. *Ovules* 2 per loculus. *Style* 1.1–1.6 mm long. *Fruits* 2–3 mm long. *Seeds* 1.6–2 mm long, 0.7–0.8 mm wide, 0.9–1.1 mm thick, deeply colliculate or tuberculate; aril 0.9–1.2 mm long. (Figure 8)

*Diagnostic features.* Distinguished from other members of sect. *Rinzia*, by the following combination of characters: leaves petiolate, usually distinctly broader than thick; flowers 7.5–13 mm diam.; ovules 2 per loculus; seeds deeply colliculate or tuberculate.

*Selected specimens examined.* WESTERN AUSTRALIA: DEC Forest Block A47883 – Mercer Rd Rock, York, 5 Sep. 2008, *L. Gargett & H. Lancaster* CJ 21 (PERTH); Dale West Rd, Beverley, 13 Sep. 1999, *F. Hort* 580 (CANB, PERTH); Mercer Rd, 0.8 km W of Browns Rd, York, 8 Sep. 2003, *F. Hort* 2040 (BRI, PERTH); Bindoon Training Centre, 25 Aug. 2015, *F. Hort* 3942 (CANB, NSW, PERTH); Calingiri Water Reserve, Fordham Rd, c. 8.75 km SSE of Calingiri townsite, 27 Oct. 2004, *F. Hort & B. Hort* 2392 (PERTH); central Needling Hills, E of York, 4 July 2005, *A. Sole & H. Green* KB 21 (PERTH).

*Distribution and habitat.* Recorded from Watheroo south to the Darling Range near Perth and south-east to near Brookton, in heath vegetation on lateritic rises or on granite. *Rinzia crassifolia* extends further north than any other member of the section. At the southernmost part of its range, *R. crassifolia* overlaps slightly with the northernmost part of the range of *R. fumana*.

*Phenology.* Flowers and fruits from July to November.

*Conservation status.* *Rinzia crassifolia* is not considered to be at risk as it is known from many localities over a range of over 220 km, including populations protected in national parks or nature reserves.

*Etymology.* From the Latin *crassus* (thick) and *-folius* (-leaved) referring to the thick leaves of the type material.

*Common name.* Darling Range *Rinzia*.

*Notes.* *Rinzia crassifolia* is very similar to *R. fumana* in habit and leaf morphology and has the same ovule number. The latter differs in having shorter, smoother seeds, which are usually very glossy, and in having five to ten stamens.

As described above, this taxon is particularly variable in its leaf morphology. Type material is at one extreme of the range of variation, having very short, thick leaves (2–3.5 mm long, 1.3–1.8 mm wide, 0.4–0.7 mm thick), hence the name *crassifolia*. In February 2009, the phrase name *R. sp.* Darling Range (*F. Hort* 2040) was applied to specimens from the Perth Region with longer (5–12 mm long), flatter leaves that tended also to be narrower (0.5–1.6 mm wide). However, some collections made since then have leaf measurements down to 4 mm long, and a recent collection from the Bindoon area (*F. Hort* 3942) has leaves down to 3.5 mm long, bridging the gap in leaf length that had originally been used to separate *R. sp.* Darling Range from *R. crassifolia*. In view of the paucity of material of the typical entity and the large degree of variability in the material housed as *R. sp.* Darling Range, it appears that the observed differences in their leaves are insufficient to treat them as separate species.

No details are known of the habit, locality, habitat or flowering time for the typical variant of *R. crassifolia*. The two collections of it were made by James Drummond on his fourth and fifth



Figure 8. *Rinzia crassifolia*, top view of flowers. Image taken by Jean Hort at Julimar Conservation Park; voucher J. & F. Hort 3664.

collecting expeditions. These two expeditions (see Erickson 1969) covered a lot of common ground between Toodyay and King George Sound and from the Stirling Range east to West Mt Barren. If the two early collections of *R. crassifolia* were made towards the northern end of the main route used at that time between the York–Toodyay area and Albany, which those two expeditions traversed, they could have been made within or adjacent to the distribution of the longer-leaved variant that has been known as *R. sp.* Darling Range.

Other characters showing great variability are flower size and colour, and the degree to which the stamens are united. A large-flowered specimen is illustrated in Figure 8. Descriptions of *R. crassifolia* given in Trudgen (1986a) and Rye (1987) are based primarily on the atypical material.

According to Trudgen (1986a: 438) ‘Occasional plants are 6-merous, their flowers having 6 petals, 6 calyx lobes, 12 stamens and 4 ovary loculi’. No such plants were observed in the current study of PERTH specimens. It seems likely that occasional flowers on typically 5-merous plants are 6-merous, as often happens elsewhere in the tribe, for example in *Astartea* DC. (Rye 2013: 194). A few flowers with only eight or nine fertile stamens were observed in the current study, with one or two of the antisepalous stamens absent or reduced to staminodes.

**13. *Rinzia dimorphandra*** (F.Muell. ex Benth.) Trudgen, *Nuytsia* 5: 430 (1986). *Baeckea dimorphandra* F.Muell. ex Benth., *Fl. Austral.* 3: 74 (1867). *Hypocalymma dimorphandrum* (F.Muell. ex Benth.) Nied., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3(7): 99 (1893). *Type*: sandy places near Cape le Grand, Western Australia, 1858–1866, *G. Maxwell s.n. (holo: MEL 72717; iso: MEL 72718)*.

*Illustrations*. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 69 (1980) [as *Baeckea dimorphandra*]; M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, second row on left (1986).

*Shrub* c. 0.2–(0.5) m, with adventitious roots from prostrate main stems. *Petioles* 0.2–0.4 mm long. *Leaf blades* narrowly elliptic to elliptic or narrowly obovate in outline, 2–4.5 mm long, 0.5–0.8 mm wide, 0.5–0.7 mm thick, acute to obtuse, entire. *Peduncles* (1)2-flowered; secondary axes  $\pm$  absent. *Bracteoles* 0.8–2.2 mm long. *Pedicels* 1–3 mm long. *Flowers* 7.5–10 mm diam. *Hypanthium* 1–1.4 mm long. *Sepals* 1–1.5 mm long. *Petals* 3–4 mm long, bright pink or rarely pale pink to white. *Stamens* 10, connate for up to 0.25 mm. *Antipetalous filaments* 1.2–1.6 mm long, 0.6–0.9 mm wide. *Antisepalous filaments* 0.7–1 mm long, 0.3–0.5 mm wide. *Anthers* 0.3–0.5 mm long. *Ovules* (2)3, never 2 in all loculi. *Style* 1.3–1.8 mm long. *Fruits* 1.7–2 mm long. *Seeds* 1.3–1.5 mm long, 0.4–0.55 mm wide, 0.55–0.7 mm thick, smooth; aril 0.7–1 mm long, fairly central or reaching to the apex of the seed.

*Diagnostic features*. Distinguished from all other members of the genus except *R. affinis* by the following combination of characters: peduncles usually 2-flowered; ovules 2 or 3 (never all 2) per loculus; seeds smooth, arillate. Distinguished from *R. affinis* by minor characters including its usually more deeply pink petals.

*Selected specimens examined*. WESTERN AUSTRALIA: Old Smokey Rd, Esperance, 3 Oct. 1995, *R.J. Cranfield* 10396 (PERTH); High Island, Duke of Orleans Bay, 20 Oct. 1985, *E. & S. Pignatti* 1233 (PERTH); Speddingup (E), c. 40–50 km N of Esperance, 9 Sep. 1997, *C.D. Turley* 4/997 (PERTH); Old Smokey Rd, near Fisheries Rd, NE of Esperance, 19 Oct. 1997, *Peter G. Wilson* 1408 & *N. Lam* (NSW, PERTH).

*Distribution and habitat*. Extends from Speddingup east to near Howick Hill, in sand, sometimes with limestone, often in *Banksia* scrub. *Rinzia dimorphandra* is geographically disjunct from most other members of sect. *Rinzia*, occurring further east than all of them except for an outlying locality of *R. sessilis*, which occurs even further east.

*Phenology*. Flowers from September to December. Mature fruits are recorded from November to January.

*Conservation status*. Not currently considered to be at risk, this species has a distribution c. 100 km long.

*Etymology*. From the Greek *dimorphos* (having two forms) and *-andrus* (-stamened), as the antipetalous stamens are much larger than the antisepalous stamens.

*Common name*. Esperance *Rinzia*.

*Notes*. This species is very similar to *R. affinis*; for the differences between the two species, see the notes under *R. affinis*. Chloroplast and ETS data (Peter Wilson pers. comm.) give different placements of this species, the former including it in sect. *Rinzia* and the latter placing it as a strongly supported sister to sect. *Discolora*. If future molecular studies establish that this species needs to be transferred to sect. *Discolora*, or placed in its own section, then at least one other species, *R. affinis* would

presumably need to be moved as well. However, since *R. affinis* is suspected of hybridising with *R. communis* of sect. *Rinzia*, the decision has been made here to give more weight to the chloroplast data and morphology, and to retain both species in sect. *Rinzia*.

According to Trudgen (1986a: 430), *R. dimorphandra* has three to five ovules per loculus but the ovule number is recorded as two or three per loculus in Blackall and Grieve (1980: 69). The current study concurs with Blackall and Grieve, recording a maximum of three ovules per loculus and occasionally only two ovules in one or two of the loculi. Seeds were found to be larger, 1.3–1.5 mm long, than the 1.1–1.3 mm recorded by Trudgen (1986a), and the aril is not always central in location as indicated in that revision.

**14. *Rinzia fumana*** Schauer, *Linnaea* 17: 239–240 (1843). *Baeckea fumana* (Schauer) F.Muell., *Fragm.* 4: 68 (1864). *Hypocalymma fumanum* (Schauer) Nied., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* 3(7): 99 (1893). *Type*: inland from King George Sound, Western Australia, Oct. 1840, J.A.L. Preiss 164 (*syn*: LD 1088555, MEL 72748).

*Illustrations*. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 68 (1980) [as *Baeckea fumana*]; M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, second row in middle (1986).

*Shrub* usually 0.1–0.3 m high, prostrate or low and widely spreading. *Petioles* 0.2–0.4 mm long. *Leaf blades* narrowly elliptic to linear in outline, 2.5–8 mm long, 0.5–1 mm wide, 0.3–0.6 mm thick, acute to obtuse, often denticulate around the apex. *Peduncles* mostly 1-flowered. *Bracteoles* 1–1.6 mm long, entire or denticulate. *Pedicels* 1.5–5.5 mm long. *Flowers* 5.5–8 mm diam. *Hypanthium* 0.6–1 mm long. *Sepals* 1–1.6 mm long. *Petals* 2.3–3.5 mm long, pink or white. *Stamens* 5–10, connate for up to 0.5 mm, free (but contiguous) when 5. *Antipetalous filaments* 0.9–1.5 mm long, 0.6–1 mm wide. *Antisepalous filaments* (when present) 0.6–1 mm long, 0.3–0.5 mm wide. *Anthers* c. 0.3 mm long. *Ovules* 2 per loculus. *Style* 0.6–1.1 mm long. *Fruits* 1.5–1.8 mm long. *Seeds* 1.3–1.5 mm long, 0.5–0.6 mm wide, 0.6–0.8 mm thick, smooth or colliculate, usually very glossy, somewhat beaked adjacent to both ends of aril; aril 0.5–0.6 mm long.

*Diagnostic features*. Distinguished from other members of sect. *Rinzia* by the following combination of characters: leaves petiolate, usually distinctly broader than thick; flowers 5.5–8 mm diam.; antipetalous filaments often 2-horned, terminating in a white band of papillae; ovules 2 per loculus, style 0.6–1.1 mm long; seeds smooth or colliculate, usually glossy.

*Selected specimens examined*. WESTERN AUSTRALIA: near Kalgan River, NE of Albany, Oct. 1903, C.R.P. Andrews s.n. (PERTH); 18 km ENE of Rocky Gully on western edge of reserve 26586, 20 Oct. 1995, A.R. Annels 5492 & T.D. Macfarlane (CANB, MJP, PERTH); Woogenilup, 18 Oct. 1962, T.E.H. Aplin 2118 (PERTH); 10 km S [of Brookton Hwy] along Watershed Rd, 19 Nov. 1981, R.J. Cranfield 1968 (PERTH); Monadnocks Conservation Reserve, Pike Rd, Wandering, 1.5 km E from Watershed Rd, 2 Nov. 2009, F. Hort 3520 (PERTH); Kamballup Golf Course, intersection of Woogenilup and Chester Pass Rd, 25 Oct. 1985, N. Hoyle 1308 (PERTH); Geekabee Hill, W of Cranbrook, 25 Oct. 1997, N. Lam, Peter G. Wilson & E.A. Brown UNSW 23742 (UNSW); Newell Rd, SW of Gura Rd pine plantation, Dryandra State Forest, 14 Sep. 1988, D. Rose 796 (PERTH); hilltop S of Brookton Hwy, 1.3 km W of Warradale Rd, Darling Range, 9 Sep. 2007, B.L. Rye 279015, M.C. Motsi, F. Hort & J. Hort (AD, PERTH); Metro Rd, S of Brookton Hwy, 18 Oct. 2010, K.R. Thiele 3886 (PERTH).

*Distribution and habitat*. Extends from the central part of the Darling Range south to Collie and south-west to near the upper Kalgan River. Occurs on granite outcrops in the far north of its range

but elsewhere occurs mainly on lateritic soils, commonly in Wandoo or Jarrah woodland or with other eucalypts dominant. *Rinzia fumana* overlaps slightly in the north with *R. crassifolia* and slightly in the east with *R. communis*, but is well separated from the other members of sect. *Rinzia*.

*Phenology.* Flowers and mature fruits recorded from July to November.

*Conservation status.* This taxon is fairly widespread, with a broad range extending for at least 260 km, and is not considered to be under threat.

*Etymology.* *Rinzia fumana* is possibly so-named because of its two distinct types of stamens, with antipetalous ones much larger than antisepalous ones, as the genus *Fumana* (Dunal) Spach of the family Cistaceae also has two kinds of androecial members, in that case staminodes and stamens.

*Common name.* Polished *Rinzia*. The common name refers to the very glossy coating on the seeds, which makes them very smooth. In a few cases the coating can be seen peeling off (e.g. on seeds in *R. Davis* 8753), revealing a dull, colliculate surface below.

*Typification.* A lectotype is not designated at this time since I may not have viewed all of the material available to Schauer. It is of note that LD 1088555 appears to bear Schauer's annotation.

*Notes.* This species has been confused with both of the species, *R. crassifolia* and *R. communis*, with which it overlaps in distribution. All three species have two ovules per loculus but *R. communis* differs from *R. fumana* in having thicker leaves, while *R. crassifolia* differs in having tuberculate seeds.

*Rinzia fumana* has, on average, the fewest stamens and shortest style in sect. *Rinzia*. Throughout the species' geographic range, stamen number varies from five to ten, with a majority of flowers having less than ten stamens.

The northernmost specimens of *R. fumana* (e.g. *K.R. Thiele* 3886) occur mainly on granite outcrops, whereas throughout the remainder of the range most specimens are recorded from lateritic sites. The largest flowers (c. 8 mm diam.) have been recorded from the northern area but all specimens have short styles.

The south-easternmost specimens (e.g. *A. Morrison s.n.* (PERTH 05886090); *N. Hoyle* 1308), from the Stirling Range and south of the Stirling Range, include the largest leaves, up to 8 mm long, and have seeds that are more obviously colliculate than usual, but this variant is too poorly known to be sure how distinctive it is.

*Rinzia fumana* commonly produces mature seeds from all or a majority of its six ovules, and seeds are present on a large proportion of the specimens. Trudgen (1986a) recorded seed length as 1.1–1.4 mm but larger measurements, of 1.3–1.5 mm, were obtained here.

**15. *Rinzia rubra*** Trudgen, *Nuytsia* 5: 427–430 (1986). *Type*: on Lake King to Salmon Gums road, Western Australia [precise locality withheld for conservation reasons], 3 November 1976, *M.E. Trudgen* 1765 (*holo*: PERTH 01631853; *iso*: CANB 367222, K 000821743, MEL 1552705, NSW 547595).

*Illustration.* M.E. Trudgen, *Nuytsia* 5: 419, Figure 2, third row at centre (1986).

*Shrub* 0.05–0.7(–1) m high. *Petioles* 0.2–0.4 mm long. *Leaf blades* usually narrowly oblong to narrowly obovate in outline, 1.5–4 mm long, 0.6–1 mm wide, 0.4–0.6 mm thick, obtuse, entire. *Peduncles* 1-flowered. *Bracteoles* 1.2–1.5 mm long. *Pedicels* 2.5–5 mm long. *Flowers* c. 9 mm diam. *Hypanthium* 1.7–2.1 mm long. *Sepals* 1–1.5 mm long. *Petals* c. 3 mm long, white. *Stamens* 10, connate for 0.6–1 mm. *Antipetalous filaments* 1.7–2 mm long, 0.6–0.8 mm wide. *Antisepalous filaments* 1.2–1.5 mm long, 0.4–0.5 mm wide. *Anthers* c. 0.4 mm long. *Ovules* 5–9 per loculus. *Style* 2–2.5 mm long. *Fruits* 2.6–3 mm long. *Seeds* 1.6–1.7 mm long, c. 0.8 mm wide, 0.8–1 mm thick, very minutely tuberculate; aril rudimentary or absent.

*Diagnostic features.* Distinguished from other members of sect. *Rinzia* in lacking an obvious aril on its seeds. Other important characters are: anther loculi protruding beyond apex of filament; ovules 5–9 per loculus; seeds minutely tuberculate.

*Selected specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 18 Sep. 1986, R.J. Hnatiuk 760891 (PERTH).

*Distribution and habitat.* Occurs in Frank Hann National Park and Bremer Range, in sandy soils with vegetation dominated by *Eucalyptus* mallee scrublands or woodlands. *Rinzia rubra* occupies a small area within the ranges of *R. communis* and *R. sessilis*.

An inaccurate distribution was given for *R. rubra* in Trudgen (1986a), partly as a result of the inclusion of specimens (*E.M. Canning* W.A./68-2526 (CBG n.v.); *K.R. Newbey* 5838) of *R. fimbriolata*, although only one of these was apparently mapped. A second reason for the map being wrong was an incorrect locality on the correctly identified specimen *K.R. Newbey* 5576. That specimen has the locality given as ‘20 km south west of Coolgardie’ (see Trudgen 1986a) but is now known to have been collected in the Bremer Range area.

*Phenology.* Flowers from July to November, with mature fruits recorded in early November.

*Conservation status.* Recently listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–). *Rinzia rubra* is restricted in its distribution, with a known range less than 25 km long, but occurs in a large national park. It is known from only four collections, the most recent in 1986, including the only collection (*R.J. Hnatiuk* 760891) cited above, which was not given by Trudgen (1986a).

*Etymology.* From the Latin *ruber* (ruddy, red) referring to the dull reddish colour on the hypanthium and sepals.

*Common name.* Red-based *Rinzia*. The hypanthium of *R. rubra* is broader at the base, and more obviously reddish, than in other members of section *Rinzia*.

*Notes.* This is a very distinctive species, differing from all other members of sect. *Rinzia* in its aril being vestigial or absent. Its ovule numbers are the highest on average for the section, up to nine per loculus. According to the protologue there can be as few as four ovules, but that may be incorrect as specimens of *R. fimbriolata* (which has 3–5 ovules per loculus) were previously included in the description. However, the protologue does not appear to have included any other characters that could be exclusive to *R. fimbriolata*.

*Rinzia rubra* seems to be more erect than most species of sect. *Rinzia* and is apparently able to regenerate from a thick rootstock after fires.

**16. *Rinzia sessilis*** Trudgen, *Nuytsia* 5: 436–437 (1986). *Type*: 10 km north of Lake Cronin, c. 84 km E of Hyden, Western Australia, 13 September 1981, K.R. Newbey 8798 (*holo*: PERTH 01631888; *iso*: CANB 367221, K 000821742, MEL 1552706, NSW 542204, PERTH 01631896).

*Illustration*. M.E. Trudgen, *Nuytsia* 5: 417, Figure 1 (1986).

*Shrub* 0.2–0.5(–0.8) m high, with main stems prostrate and shorter branches erect. *Leaves* sessile, oblong to almost circular or narrowly ovate in outline, 0.8–3.5 mm long, 0.4–0.8 mm wide, 0.4–0.6 mm thick, usually obtuse, glabrous or ciliate, sometimes with tangled white hairs up to 0.5 mm long. *Peduncles* 1-flowered. *Bracteoles* 0.8–1.7 mm long. *Pedicels* 0.6–2.2 mm long. *Flowers* 5–9 mm diam. *Hypanthium* 0.8–1 mm long. *Sepals* 0.6–1.2 mm long, sometimes ciliate. *Petals* 2–3.5 mm long, usually pale pink. *Stamens* 10, connate for 0.4–0.8 mm. *Antipetalous filaments* 1.2–1.7 mm long, 0.5–0.9 mm wide. *Antisepalous filaments* 0.7–1.2 mm long, 0.3–0.5 mm wide. *Anthers* 0.3–0.4 mm long. *Ovules* 2 per loculus. *Style* 0.9–2 mm long. *Fruits* 1.7–2.3 mm long. *Seeds* 1.35–1.7 mm long, 0.6–0.85 mm wide, 0.7–1 mm thick, colliculate; aril 0.55–0.7 mm long.

*Diagnostic features*. Distinguished from other members of sect. *Rinzia* by its sessile leaves and the white hairs (when present) on its leaf margins and sepals. Other important characters are: ovules 2 per loculus; seeds colliculate.

*Selected specimens examined*. WESTERN AUSTRALIA: Oldfield 1343 [28 km NW of Cascade], 24 May 1993, R. Bruhn 3/24593 (PERTH); S of Jilakin Rocks Rd, W boundary of Dragon Rocks Nature Reserve, 11 Oct. 1991, A.M. Coates 3209 B (BRI, PERTH); c. 3 km SSE of Tamar Hill, Bremer Range, 15 Sep. 1994, N. Gibson & M. Lyons 1767 (AD, PERTH); c. 6.27 km S of Mt Holland, 26 Sep. 2009, W.A. Thompson & J. Allen 1294 (PERTH); 84.5 km W of Peak Charles turnoff on Lake King Rd, Frank Hann National Park, Roe District, 16 Oct. 1997, Peter G. Wilson 1395 & N. Lam (NSW, PERTH).

*Distribution and habitat*. Extends from north-west of Mt Holland south-east to near Pyramid Lake, with an isolated collection more than 200 km further east at Ponier Rock (K.R. Newbey 7323). The majority of the known localities are within the Coolgardie bioregion of the Eremaean Botanical Province, with the remainder in adjacent parts of the South West Botanical Province. Occurs in varied habitats including sandy soils near salt lakes, and elevated laterite.

*Phenology*. Flowers mainly from July to October. Mature fruits are recorded in September and October.

*Conservation status*. The main range of this species is more than 225 km long, but including the outlying eastern occurrence increases the overall distribution to over 450 km. It is not considered to be under threat.

*Etymology*. The epithet refers to the sessile leaves.

*Common name*. Sessile-leaved *Rinzia*.

*Notes*. This is the only species of sect. *Rinzia* with uniformly sessile leaves and the only one that sometimes has an obvious border of white cilia on the leaf margins, giving it a very distinctive

appearance. All specimens collected west of longitude 120° E have more or less glabrous, entire leaves, whereas those collected east of 120° have leaves varying from sparsely ciliolate to densely ciliate. Bracteoles and sepals have similar margins to the young leaves of each specimen, i.e. being densely ciliate if the leaves are densely ciliate.

One atypical specimen from Frank Hann National Park, *D. Butcher* 323, is possibly a hybrid between *R. sessilis* and *R. communis*. This specimen has leaves that are petiolate like those of *R. communis* but with white hairs on the margin like those of *R. sessilis* in that area. *Rinzia sessilis* also overlaps in range with *R. rubra*.

*Rinzia sessilis* occasionally has the anther loculi protruding above the apex of the filament; in this respect it may be intermediate between *R. rubra* and the other members of sect. *Rinzia*.

**Rinzia** sect. **Semasperma** Rye, *sect. nov.*

*Typus*: *Rinzia orientalis* Rye.

‘*Semasperma*’ ms in B.L. Rye, *Nuytsia* 19: 320 (2009).

Mat-like to erect *shrubs* up to 1.3 m high, sometimes rooting adventitiously from horizontal stems. *Leaves* concolorous. *Peduncles* up to 0.3 mm long, 1-flowered. *Pedicels* ± absent or up to 5 mm long. *Sepals* brown to very dark red with a broad, petaline or scarious margin. *Petals* white or pale pink. *Stamens* 5–20, when 5 all antipetalous, when more numerous then either ± equidistant or in antipetalous triads. *Filaments* usually free, rarely in shortly connate triads, ± terete, < 0.2 mm wide; apex below top of anther. *Anthers* versatile. *Ovary* 1/2–3/4-inferior; summit convex; ovules 2 per loculus. *Style* 0.8–1.8 mm long; stigma capitate or peltate. *Fruits* fairly erect, c. 1/2-inferior or largely superior. *Seeds* 1.1–1.5 mm long, brown, minutely colliculate; inner surface with a large whitish cavity divided longitudinally into three parts by two ridges and surrounded by a narrow raised rim, the ridges very stiff.

*Diagnostic features.* Distinguished from other sections of *Rinzia* by its seed morphology, having a large cavity on the inner surface that is divided into three sections by two longitudinal partitions. Other important characters are the narrow filaments, versatile anthers and 2 ovules per loculus.

*Distribution and phenology.* This is the only section to occur both in south-western and south-eastern Australia (Figure 3). There is a large disjunction between the single Western Australian species and the two eastern ones, with flowering appearing to be more seasonal in the east.

*Etymology.* From the Greek *sema* (sign, mark) and *sperma* (seed) in reference to the distinctive, large cavity on the inner surface of the seeds.

*Notes.* The inclusion of *R. icosandra* in sect. *Semasperma* is based on its morphology and is supported by unpublished ETS data (see ‘Molecular studies’ section). Published studies based on chloroplast molecular data (Lam *et al.* 2002; Wilson *et al.* 2004), however, place it as the sister to section *Rinzia*.

The ridges within the whitish cavity on the inner surface of the seed have the appearance of an elaiosome, but are much harder than the remainder of the seed and therefore seem to have a structural rather than a nutritional function.

**17. *Rinzia ericaea* (F.Muell. ex Benth.) Rye, *comb. nov.***

*Baeckea ericaea* F.Muell. ex Benth., *Fl. Austral.* 3: 77 (1867). *Type*: Murray [Murray River], scrub, Victoria, 1854, *F. Mueller s.n.* (*lecto*: MEL 72733, here designated; *?isolecto*: MEL 72734); Wimmera [Wimmera River], Victoria, *J. Dallachy s.n.* (*syn*: K 000843224, MEL 72735, NSW 123001).

*Illustrations*. J.P. Jessop & H.R. Toelken (eds), *Fl. S. Austral.* (5<sup>th</sup> edn) 2: 894, Figure 462C (1986); G. Walsh & T.J. Entwisle (eds), *Fl. Victoria* 3: 1037, Figure 214C (1996) [both as *Baeckea ericaea*]; drawing on *H.H.D. Griffith s.n.* (AD 96828146).

*Shrub* up to 0.3 m high but usually low and mat-like, sometimes rooting adventitiously from horizontal stems; flowering branchlets with 1 or 2 pairs of flowers at or close to the end. *Leaves* appressed or antrorse and up to c. 3 mm long on fast-growing shoots, antrorse to patent on lateral branchlets. *Foliar collectors* visible on very young leaves. *Petioles* 0.1–0.3 mm long. *Leaf blades* narrowly ovate to narrowly oblong in outline, 1.3–3.2 mm long, 0.4–0.8 mm wide, 0.3–0.5 mm thick, obtuse, ciliate; adaxial surface flat or slightly convex; abaxial surface deeply convex or somewhat angular; oil glands in 1 main row on each side of midvein. *Peduncles* ± absent. *Bracteoles* persistent, cordate, 0.8–1.4 mm long, about as wide as long, herbaceous, acute or somewhat acuminate, keeled, entire or denticulate. *Flowers* 4–6 mm diam. *Hypanthium* 0.8–1.2 mm long, c. 2 mm diam.; free part 0.3–0.5 mm long. *Sepals* depressed-elliptic to depressed-oblong or depressed-ovate, 0.8–1.3 mm long, 1.2–1.8 mm wide, with midrib usually forming a whitish low ridge, which sometimes branches distally, denticulate to ciliate-laciniate, brown or red-brown with a pale margin 0.2–0.4 mm wide; auricles (of outer sepals) up to 0.35 mm wide. *Petals* 1.4–2 mm long, white. *Stamens* usually 15 in close groups of 3 opposite the petals, with none opposite the sepals, usually with very little separation on each side to the adjacent short stamens, sometimes contiguous with and rarely united at base to an adjacent stamen. *Triads* with central filament 0.5–0.8 mm long and marginal filaments 0.3–0.6 mm long. *Anthers* 0.25–0.35 mm long. *Ovary* c. 1/2–2/3-inferior. *Style* 0.8–1.2 mm long; stigma 0.15–0.2 mm diam. *Fruits* with petals and stamens usually persistent, c. 1/2-inferior or largely superior, 1.4–1.5 mm long, 1.7–2.5 mm diam. *Seeds* 1.1–1.3 mm long, 0.5–0.7 mm wide, 0.6–0.7 mm thick, golden-brown; inner cavity central or slightly above the centre, 0.5–0.6 mm long, about as wide as long.

*Diagnostic features*. Distinguished from other members of sect. *Semasperma* by its persistent bracteoles, ± sessile flowers, and constant stamen number of 15 (in antipetalous triads).

*Distribution and habitat*. Occurs from near the Coorong area of South Australia east to the Big and Little Deserts of far-western Victoria, with a disjunct western occurrence on Kangaroo Island in South Australia (Figure 9A).

*Etymology*. From the Latin *erica* (heath).

*Common name*. Mat Heath-myrtle.

*Typification*. Two type specimens from MEL are known to have been examined by Benthham (as indicated by the letter B written on a down-turned corner of their labels), one from ‘Murray scrub’ collected by Mueller (MEL 72733) and the other from the Victorian Wimmera district by Dallachy (MEL 72735); both are labelled ‘*Baeckea ericaea* Ferd. Mueller’. A third specimen (MEL 72734), presumed to be part of Mueller’s Murray scrub collection, lacks any indication that Benthham saw it and is labelled ‘*Schidiomyrtus ericaea*’. All three specimens are in flower and are of similar quality. The *Mueller s.n.* (MEL 72733) specimen known to have been seen by Benthham is selected as the lectotype.

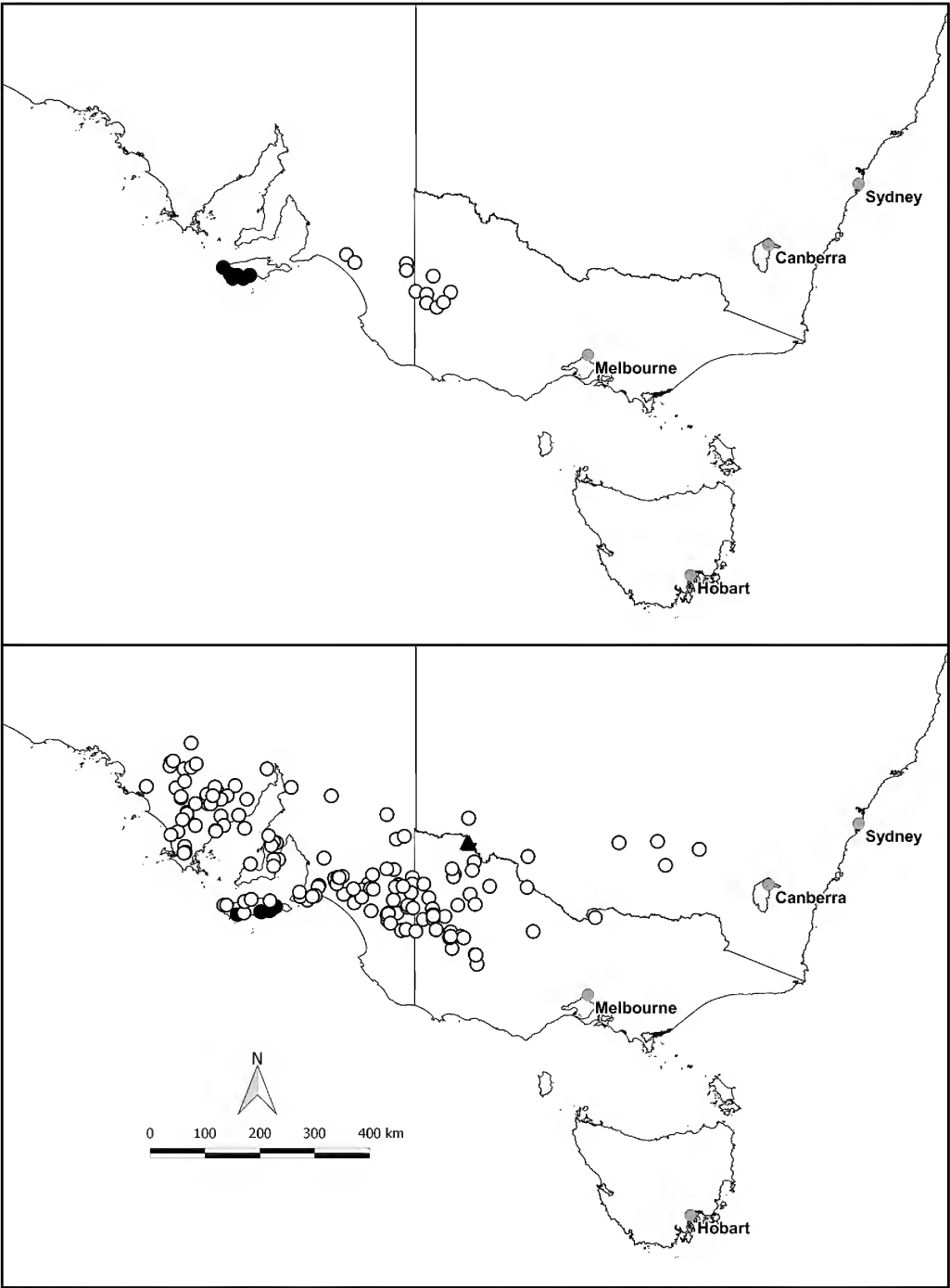


Figure 9. Distributions of the south-eastern Australian species of *Rinzia*. A – *R. ericaea* subsp. *ericaea* (○) and *R. ericaea* subsp. *insularis* (●); B – *R. orientalis* specimens with mostly 10 stamens (○), specimens with mostly 5–7 stamens (●) and specimens with up to 13 stamens (▲).

*Notes.* This species was first treated as a variant of *Baeckea microphylla* Sieber ex Spreng (Mueller 1858: 31) in a note indicating that specimens of *B. micrantha* with 15 stamens had previously been distributed either as *B. ericaea* F.Muell. ms or *Schidiomyrtus ericaea* F.Muell. ms. Benth (1867) referred to this paper when he took up Mueller's manuscript name, stating 'closely resembling the smaller specimens of *Micromyrtus microphylla*, but quite different in the structure of the flowers'. *Baeckea microphylla* [= *M. microphylla* (Sieber ex Spreng.) Benth.], now known as *Micromyrtus ciliata* (Sm.) Druce, has only five stamens and bears only a superficial resemblance to *R. ericaea*.

*Rinzia ericaea* has the smallest flowers in the genus, with petals 1.4–2 mm long. It has a number of unique characters that make it very easy to identify, including its more or less sessile flowers with the hypanthium largely adnate to the ovary. The sepals sometimes have white venation comprising a single lateral vein on each side of an obvious midvein, which often protrudes from the flat summit of the flower buds. The bracteoles and petals persist in fruit.

Two geographically separated subspecies are recognised, occurring on the mainland and Kangaroo Island respectively. *Rinzia ericaea* was previously described briefly in Trudgen (1986) and Jeanes (1996) but without the Kangaroo Island specimens treated separately.

### Key to subspecies

1. Leaves often < 1.7 mm long, usually 0.4–0.5 mm thick (rarely down to 0.35 mm thick when only very short leaves 1.3–1.7 mm long are present), antrorse or widely antrorse on lateral branchlets (the branchlets of varied sizes including some 10–20 mm long), mostly appressed or antrorse elsewhere. Sepals with the midvein obvious and often also the lateral veins clearly visible (Coorong area, S.A.–Big & Little Deserts, Vic.)..... **17a. *R. ericaea* subsp. *ericaea***
- 1: Leaves 1.7–3.2 mm long, 0.3–0.4 mm thick, mostly widely antrorse to patent on numerous patent lateral branchlets (the branchlets 4–8 mm long), those on fast-growing shoots (when present) appressed or antrorse. Sepals often with the midvein not very obvious or very short, the lateral veins not visible or very obscure (Kangaroo Island, SA)..... **17b. *R. ericaea* subsp. *insularis***

### 17a. *Rinzia ericaea* (F.Muell.) Rye subsp. *ericaea*

*Shrub* either low and mat-like or erect and up to 0.3 m high, sometimes rooting adventitiously from horizontal stems; lateral branchlets patent or antrorse, including some 10–20 mm long. *Leaves* appressed or antrorse and up to c. 3 mm long on fast-growing shoots, antrorse or widely antrorse where crowded on lateral branchlets, sometimes with the keel protruding slightly beyond the apex of the leaf. *Leaf blades* narrowly ovate to narrowly oblong in outline, mostly 1.3–1.7 mm long, 0.4–0.8 mm wide, (0.35–)0.4–0.5 mm thick, margins ciliolate. *Sepals* with midvein always obvious; lateral veins often visible. *Antipetalous filaments* slender, usually with very little separation on each side to the adjacent short stamens, sometimes contiguous with, and rarely united at base to, an adjacent stamen.

*Selected specimens examined.* SOUTH AUSTRALIA: between Western Flat and Bordertown, 14 Oct. 1961, *D. Hunt* 212 (AD); c. 24 km NE of Keith, 23 Aug. 1961, *Paul G. Wilson* 1913 (AD). VICTORIA: Wyperfeld National Park, SW corner of Western Sector near dozed track, 8 Oct. 1968, *A.C. Beauglehole* 29095a & *E.W. Finck* (MEL); central Little Desert National Park, NE of Goroke Post

Office, Wimmera study area, 5 Sep. 1986, *A.C. Beauglehole* 83752 (PERTH); Little Desert, beyond salt lake from Kiala, 17 Oct. 1963, *M.E. Phillips s.n.* (CBG, NSW).

*Distribution and habitat.* Extends from near the Coorong area in south-eastern South Australia east to the Big and Little Deserts of far-western Victoria (Figure 9A), mostly occurring in sandy soils on dunes and in dry heathlands.

*Phenology.* Flowers from August to November.

*Conservation status.* This subspecies is widespread and relatively common, and is not considered to be under threat.

*Notes.* This subspecies has been recorded growing with *R. orientalis* (see notes under that species). It usually has shorter leaves than subsp. *insularis*, but on rapidly growing shoots the leaves tend to be just as long (see notes under subsp. *insularis*).

**17b. *Rinzia ericaea* subsp. *insularis* Rye, *subsp. nov.***

*Typus:* 1 mile [1.6 km] from Remarkable Rocks, Flinders Chase, Kangaroo Island, South Australia, 29 September 1965, *M.E. Phillips s.n.* (*holo:* AD 96807607; *iso:* CBG 020868).

*Shrub* < 0.3 m or rarely up to 0.6 m high, usually prostrate or low and mat-like, single-stemmed at the base, densely branched above, with many short, patent lateral branchlets 4–8 mm long. *Leaves* mostly widely antrorse to patent and densely arranged on the lateral branchlets, but those on fast-growing shoots (when present) appressed or antrorse, 1.7–3.2 mm long, 0.4–0.6 mm wide, 0.3–0.4 mm thick. *Sepals* with midvein visible but not always obvious; lateral veins invisible or very obscure. *Antipetalous filaments* free, with a distinct or slight separation on each side to the adjacent short stamens.

*Diagnostic features.* Distinguished from the other subspecies by its less thickened, usually longer leaves and its different overall appearance, with many short lateral branchlets perpendicular to the main stems and with the leaves very densely arranged and widely antrorse to patent. It can usually also be distinguished by its sepals having less obvious venation, with lateral veins not or scarcely visible.

*Other specimens examined.* SOUTH AUSTRALIA: near Kelly Hill Caves, SW part of Kangaroo Island, 5 Nov. 1958, *H. Eichler* 15221 (AD); immediately S of Mt Stockdale, Kangaroo Island, 3 Jan. 1966, *H. Eichler* 18570 (AD); mouth of Stunsail River, Kangaroo Island, 28 Nov. 1971, *G. Jackson* 899 (AD); Kangaroo Island, Oct. 1908, *H.H.D. Griffith s.n.* (AD); 5 mile [8 km] from Rocky River, Western Highway, Kangaroo Island, 27 Sep. 1965, *M.E. Phillips* SA/65 859 (CBG); Ravine de Casaar, Kangaroo Island, 1 Mar. 1886, *O. Tepper* 101 (AD, MEL); Karutha road to Mt Ingles, Kangaroo Island, 12/13 Nov. 1886, *O. Tepper* 35 (AD, MEL); head of Cygnet to Karutha, Kangaroo Island, 4 Mar. 1886, *O. Tepper* 47 (MEL).

*Distribution and habitat.* Endemic to Kangaroo Island, South Australia (Figure 9A), recorded in sandy soil, sometimes or always over limestone, in scrub.

*Phenology.* Flowers and mature fruits mainly from September to November, with one flower also observed (on *H. Eichler* 18570) in early January.

*Conservation status.* This taxon is geographically restricted and its conservation status has yet to be assessed.

*Etymology.* The epithet is Latin and means pertaining to islands, a reference to its distribution on Kangaroo Island.

*Common name.* Island Heath-myrtle.

*Notes.* After pressing, many specimens described as being prostrate on their labels appear to be more erect, but the presence of minute sand grains along their stems suggests that they were prostrate prior to pressing. As the fruits develop their diameter increases, the sepals also become wider (up to at least 2 mm), and the stamen groups become more widely separated.

**18. *Rinzia icosandra* (F.Muell. ex Benth.) Rye, *comb. nov.***

*Baeckea crassifolia* var. (?) *icosandra* F.Muell. ex Benth., *Fl. Austral.* 3: 76–77 (1867). *Type:* limestone cliffs towards the Great Australian Bight, Western Australia, 1863, G. Maxwell *s.n.* (*syn:* K 000843226, MEL 72605 & 72606, PERTH 03344398).

*Illustrations.* Drawing by C.A. Gardner on *J.P. Brooks s.n.* (PERTH 03344266); W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 81 (1980) [as *Baeckea crassifolia* var. *icosandra*].

*Shrub* (0.2–)0.3–1.3 m tall, up to at least 0.7 m wide, erect or spreading, single-stemmed or multi-branched at base; adventitious roots apparently absent; flowering branchlets with 1–4 pairs of flowers at or close to the end of the branchlet (sometimes apparently with 2 peduncles in an axil but these probably represent an extremely reduced lateral shoot with a single pair of axillary flowers). *Foliar collectors* present on young leaves. *Leaves* appressed or antrorse. *Petioles* 0.2–0.4 mm long. *Leaf blades* elliptic to narrowly oblong in outline, 1.5–3.5 mm long, 0.6–0.8 mm wide, 0.6–0.8 mm thick, usually obtuse, sometimes with a mucro up to 0.1(–0.15) mm long, entire or denticulate; adaxial surface flat or slightly convex; abaxial surface semi-elliptic, oil glands in 1 or 2 main rows on each side of midvein. *Bracteoles* usually caducous or deciduous, 1.5–2.5 mm long, less than half as wide as long, papery-scarious, entire. *Pedicels* 1.3–5 mm long. *Flowers* usually 6–9 mm diam. *Hypanthium* 1–1.5 mm long, *c.* 2–2.5 mm diam.; free part 0.5–0.8 mm long. *Sepals* triangular to depressed-ovate, 0.8–1.4 mm long, 1.2–1.7 mm wide, often somewhat keeled at base, red-brown to dark maroon, with a whitish margin 0.2–0.3 mm wide, denticulate or laciniate; auricles absent. *Petals* 1.5–3.5 mm long, pink or white. *Stamens* (11–)13–20, with 1–3 small, usually  $\pm$  equidistant stamens in each gap between the large antipetalous stamens, the most common number 15, when 20 occurring both opposite and alternating with the sepals and petals. *Antipetalous filaments* 0.6–1 mm long, up to *c.* twice as long as the other filaments. *Anthers* 0.2–0.3 mm long. *Ovary* 1/2- to almost fully inferior. *Style* 1.4–1.8 mm long; stigma 0.1–0.2 mm diam. *Fruits* *c.* 2/3-superior at maturity, *c.* 1.8 mm long, *c.* 2.2 mm diam., up to 6-seeded. *Seeds* 1.2–1.5 mm long, 0.5–0.7 mm wide, 0.6–0.8 mm thick; testa golden-brown or brown; inner cavity often towards the base of the seed but sometimes more central, 0.7–0.9 mm long, longer than wide. (Figure 10)

*Diagnostic features.* Distinguished from other members of sect. *Semasperma* by the following combination of characters: bracteoles deciduous; pedicels 1.3–5 mm long; sepals red-brown to dark maroon; stamens usually more than 13,  $\pm$  equidistant.

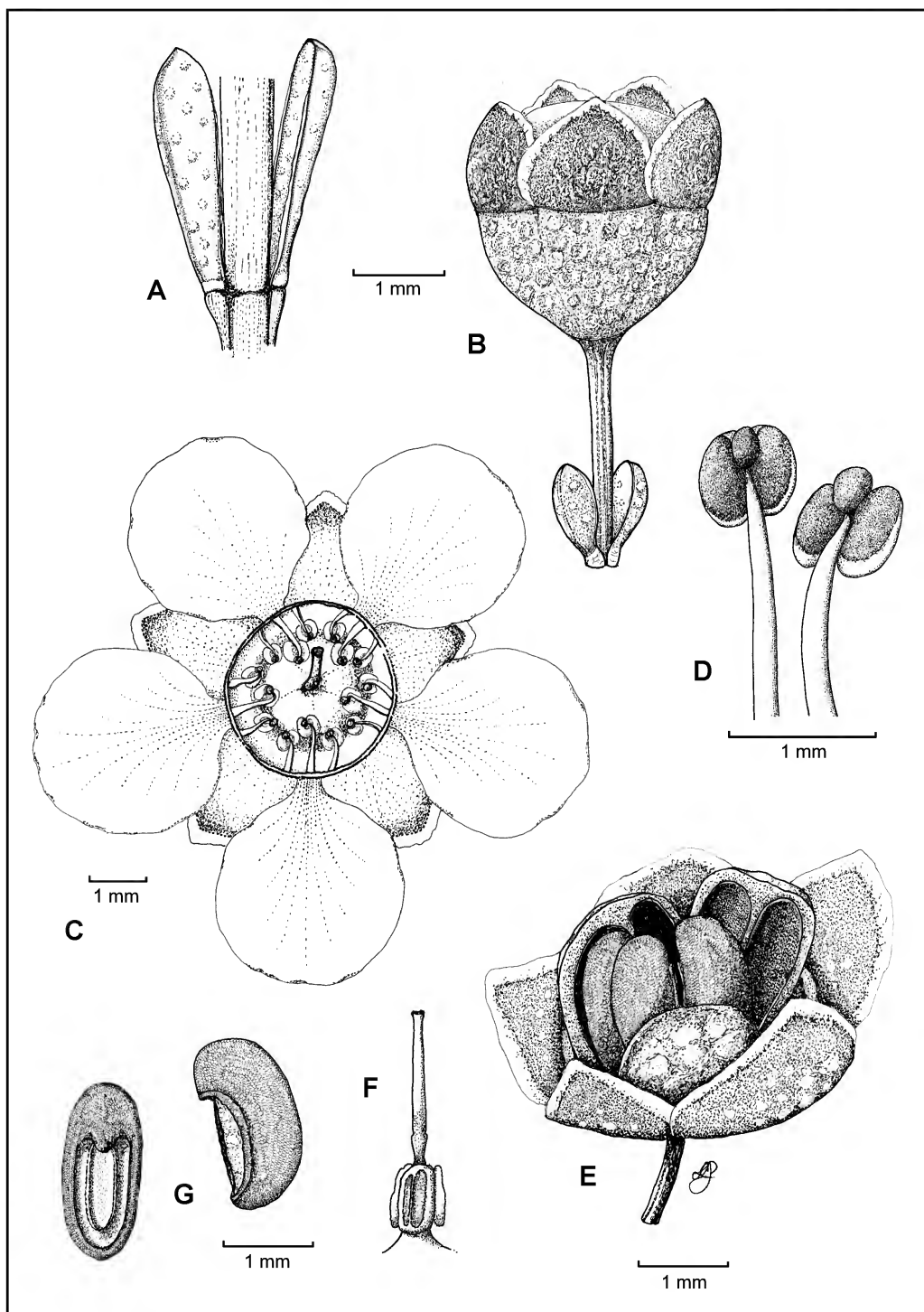


Figure 10. *Rinzia icosandra*. A – opposite leaves; B – minute peduncle, bracteoles, long pedicel and flower bud; C – flower; D – stamens; E – fruit; F – placentas and style; G – inner and side views of seed. Drawn by L. Cobb from *R. Bruhn* 10/14895 CAS (A–D) and *L. Cambell, T. Stone & Yoshi s.n.* (E–G).

*Selected specimens examined.* WESTERN AUSTRALIA: Israelite Bay, Sep. 1901, *J.P. Brooks s.n.* (PERTH); Cascade Rd, adjacent to locality 35, 28 Aug. 1995, *R. Bruhn* 10/14895 CAS (PERTH); SE corner of Reserve 24952, c. 300 m from highway, W of Scaddan, 7 Oct. 1998, *L. Cambell, T. Stone & Yoshi s.n.* (PERTH); W end of Great Australian Bight, 1877, *Carey s.n.* (MEL 73184); near Mt Ney, 9 Aug. 1980, *M.A. Clements* 1870 (CBG); Wittenoom Hills, 9 June 1972, *T.C. Daniell s.n.* (PERTH); 2.7 km S along Dempster Rd from junction of Lignite Rd, 65 km E of Scaddan, 22 June 2006, *R. Davis* 11034 (AD, PERTH); Mt Ragged on SW corner, 16 Sep. 1971, *N.G. Marchant* 71/499 (CANB, PERTH); 6 km W of Salmon Gums, 10 Mar. 1980, *K.R. Newbey* 6703 (PERTH); c. 3.5 km NE of intersection of Dalyup Rd and Loffler Rd, Scaddan, 21 Sep. 1998, *E.M. Sandiford* 114 (PERTH); extension of Howick Rd, 6.4 km NW of Coolinup Rd, 30 Aug. 2006, *M.E. Trudgen & B. Moyle* MET 22529 A (AD, BRI, CANB, K, MEL, PERTH); 17 km NE of Scaddan on Truslove Rd, 16 Aug. 1982, *P. van der Moezel* 111 (PERTH); S of Grasspatch, 1 Sep. 1917, *J.H. Willis s.n.* (MEL); 13.9 km NW along Kau Rock Rd from intersection with Coolinup Rd, 21 Oct. 1997, *Peter G. Wilson* 1418 & *N. Lam* (PERTH).

*Distribution and habitat.* Occurs in the south-east of the South West Botanical Province of Western Australia, extending from near Lort River east to near Israelite Bay, in sandy soils in mallee-dominated vegetation or shrublands, sometimes with *Cyathostemon*. This is the westernmost part of the distribution of *Rinzia* sect. *Semasperma* shown in Figure 3.

*Phenology.* Flowers have been recorded almost all year round, peaking between May and September, with mature fruits with seeds from August to October and in March.

*Conservation status.* This species is not considered to be under threat.

*Etymology.* From the Greek *icosandrus* (with 20 stamens), as this species has up to 20 stamens.

*Common name.* Recherche Mainland *Rinzia*. *Rinzia icosandra* occurs across the full longitudinal extent of the Archipelago of the Recherche, but on the mainland to the north of it rather than on the islands themselves.

*Small-flowered variant.* A small-flowered specimen (*J.P. Brooks s.n.* NSW, PERTH 03344266) with only 11 or 12 stamens is recorded from Israelite Bay. Drawings by C.A. Gardner on the PERTH specimen show half of a flower with six stamens, and the few flowers examined in this study had either 11 or 12 stamens. If these two specimens do come from Israelite Bay itself then they are more than 30 km west of all other known localities. A recent attempt to recollect the species in the Israelite Bay area was unsuccessful.

*Notes.* Mueller (1864) included this Western Australian taxon within *Baeckea crassifolia*, which he indicated as occurring at the western extreme of the Great Australian Bight as well as in south-eastern Australia. Bentham (1867: 77) was clearly unsure of its status and suggested it might be better treated as a form of *B. ericaea*, presumably because it was more similar to that species in its stamen number. The many morphological similarities between the three species now known as *R. ericaea*, *R. icosandra* and *R. orientalis* suggest that they are all closely related, but only the two eastern species group together in the molecular study of Lam *et al.* (2002).

*Rinzia icosandra* tends to be a larger plant than its two eastern relatives, with more papery bracteoles and longer pedicels. More subtle differences are its more obvious foliar colleters (these only visible on very young leaves of the eastern species) and its more closely pitted-rugose hypanthium. It may

also tend to have a more superior fruit and seeds with a longer (and more elongated) inner cavity that is more skewed towards the base than in the eastern species, but seeds with a more central cavity have also been observed in *R. icosandra*.

*Rinzia icosandra* is readily distinguished from *R. ericaea* by its pedicellate flowers, deciduous bracteoles, less distinctly ribbed sepals and usually by its more equidistant stamens. It can usually be readily distinguished from *R. orientalis* by its higher stamen numbers, but the Israelite Bay specimens have low stamen numbers, within the maximum part of the range of stamen numbers found in *R. orientalis*. *Rinzia orientalis* has very dark sepals contrasting in colour with the hypanthium in the dried state, whereas *R. icosandra* has somewhat paler sepals more similar in colour to the hypanthium after they have dried, often with a narrower pale margin and more diffuse protrusions of dark colouring into them, and a somewhat more thickened or prominently glandular centre-base. Generally, these characters are not as reliable as the characters listed above, separating *R. icosandra* from all of the eastern material. In any case, the large geographic separation of *R. icosandra* and *R. orientalis*, on opposite sides of the Great Australian Bight, means that they are unlikely ever to be confused.

There is considerable variation within *R. icosandra*. Apart from the small-flowered variant noted above, the lowest stamen number recorded for *R. icosandra* is 13 in two flowers from *E.M. Sandiford* 124, while 15 (as shown in Figure 10C) is the most common number. The maximum stamen number of 20 is rare, but was observed on one flower of an isotype (MEL 72606) that had been seen by Bentham. Despite choosing the epithet *icosandra*, Bentham (1867: 76) did note that there were often only two stamens between the antipetalous ones (rather than the three needed to make the total number of stamens in a flower 20).

Until they are shed, the scarious bracteoles fully enclose the young to late buds, and those shed at the latest stage or those on specimens with the longest pedicels are up to 2.5 mm long, such as on *K.R. Newbey* 6703. There are sometimes also much smaller bracts or bract-like structures at the base of the pedicels (e.g. reddish ones c. 0.5 mm long on *T.C. Daniell s.n.*, PERTH 03344290); these are much more persistent and herbaceous than the bracteoles.

One atypical specimen, *P. van der Moezel* 111, is unique in having broad, flat colleters up to 0.5 mm long, with up to 3 opposite each petal. It is also unusual in having some leaves more pointed than usual, with a mucro up to 0.15 mm long.

#### 19. *Rinzia orientalis* Rye, *nom. nov.*

*Baeckea crassifolia* Lindl. in T.L. Mitchell, *Three Exped. Interior E. Austral.* 2: 114 (1838). *Baeckea crassifolia* Lindl. var. *crassifolia*. Type: interior of New Holland [probably lower Darling River near Burtundy, New South Wales], on Major Mitchell's expedition, [probably 2 June] 1836, *T.L. Mitchell* 194 (?holo: CGE n.v., microfilm seen; ?iso: K 000843227, MEL 72576 lower left piece).

*Baeckea crassifolia* var. *pentamera* J.Black, *Trans. Proc. Roy. Soc. S. Austral.* 59: 259–260 (1935). Type: Kangaroo Island, South Australia, November 1934, *A.B. Cashmore s.n.* (holo: AD 97642077 specimen and notes on left side of sheet).

*Illustrations.* J.P. Jessop & H.R. Toelken (eds), *Fl. S. Austral.* (5<sup>th</sup> edn) 2: 894, Figure 462B (1986); N. Bonney & A. Miles, *What Seed is That?* p. 83 (1994); N.G. Walsh & T.J. Entwisle (eds), *Fl. Victoria* 3: 1037, Figure 214F (1996); G.J. Harden (ed.), *Fl. New South Wales* 2: 214 (2002); [all as *Baeckea crassifolia*]; drawing on *T.B. Cleland s.n.* (AD 96827028).

*Shrub* 0.2–0.75 m high, commonly erect, single-stemmed at the base; flowering branchlets with 1 or 2 pairs of flowers (or 1 or 2 solitary flowers) at or close to the end. *Foliar collectors* present on very young leaves but sometimes obscure. *Leaves* usually mostly widely antrorse. *Petioles* 0.2–0.3 mm long. *Leaf blades* elliptic to narrowly oblong in outline, 1.4–5(–6) mm long, 0.5–0.7 mm wide, 0.4–0.6 mm thick, obtuse, entire, the margin forming a slight rim or a narrow scarious projection; adaxial surface concave, flat or convex; abaxial surface rounded-convex or convex with flattened sides, with oil glands in 1 or 2 main rows on each side of midvein. *Bracteoles* caducous, 1–1.5 mm long, longer than wide, scarious, entire. *Pedicels* 0.8–1.5 mm long. *Flowers* 5–8 mm diam. *Hypanthium* 1.1–1.4 mm long, up to 3 mm diam.; free part 0.4–0.7 mm long. *Sepals* triangular to depressed-ovate, 0.8–1.3 mm long, 1.2–1.4 mm wide, very dark red with a whitish border 0.2–0.4 mm wide, acute or obtuse, entire or denticulate; auricles absent. *Petals* 2.2–3.1 mm long, white or pale pink. *Stamens* 5–10(–13), usually 10 opposite the sepals and petals, when 5 all antipetalous. *Antipetalous filaments* 0.7–1.1 mm long, tapering to apex. *Antisepalous filaments* (when present) 0.4–0.6 mm long. *Anthers* 0.3–0.35 mm long. *Ovary* largely or fully inferior. *Style* 0.8–2.2 mm long; stigma 0.1–0.2 mm diam. *Fruits* c. 1/2-inferior or largely superior, 1.7–1.8 mm long, 2–2.5 mm diam., 1(–4)-seeded. *Seeds* 1.3–1.6 mm long, 0.5–0.75 mm wide, 0.7–0.9 mm thick, brown; inner cavity usually central or slightly above the centre, 0.6–0.8 mm long, 0.5–0.7 mm wide.

*Diagnostic features.* Distinguished from other members of sect. *Semasperma* by the following combination of characters: bracteoles caducous; pedicels 0.8–1.5 mm long; stamens usually 5–10, antipetalous or opposite the sepals and petals.

*Selected typical specimens examined.* SOUTH AUSTRALIA: Ferries McDonald National Park, 22 Aug. 1973, *J. Carrick* 3389 (AD); Caralue Bluff, 27 km SW of Kimba, 19 May 1974, *M.D. Crisp* 810 (AD); Hundred of Makin, c. 23 km NE of Keith, 23 Aug. 1961, *N.N. Donner* 153 (AD); 4 mi. [6.5 km] N of Mt Hope Homestead, 22 Sep. 1965, *M.E. Phillips s.n.* (AD, CBG). NEW SOUTH WALES: Balranold, 20 July 1942, *R.V. Boynton s.n.* (NSW 122880); 4 km W of Kamarah, c. 50 km E of Griffith, 13 Nov. 1975, *M.D. Crisp* 1514 (CBG). VICTORIA: Wyperfeld National Park, SW corner of Western Sector near dozed track, 8 Oct. 1968, *A.C. Beauglehole* 29095b & *E.W. Finck* (MEL); Yanac Bushland Reserve, Wimmera study area, 9 Sep. 1986, *A.C. Beauglehole* 84017 (PERTH); Big Desert, Murrayville Track, c. 35 km SSE of Murrayville, 25 Aug. 1250, *N.G. Walsh* 1983 (PERTH).

*Selected long-leaved specimens examined.* SOUTH AUSTRALIA: Telowie Gorge, Flinders Range, 22 Aug. 1959, *R. Filson* 1391 (MEL); Eyre Hwy, near Lincoln turn-off, c. 50 km N of Whyalla, 2 Aug. 1969, *G. Gardiner s.n.* (AD); Kododa Hill, c. 17 km S of Yardea, 8 Aug. 1972, *A.G. Spooner* 2523 (AD); near summit of Mt Nott, Gawler Range, 9 km S of Thurlgee Stn, 1 Oct. 1972, *D.E. Symon* 8044 (ADW); rocky rises 6 km NW of Pine Lodge, Gawler Range, 19 km WSW of Yardea Stn, 10 Oct. 1972, *D.E. Symon* 8189 (ADW); Mt Dauble, Gawler Range, 4 Oct. 1972, *J.Z. Weber* 3366 (AD).

*Specimens with up to 13 stamens examined.* VICTORIA: SE of Red Cliffs, 200 yd [0.2 km] W of Stewart State School, 15 Aug. 1967, *J. Cullimore* 25 (MEL); NW Stewart, 1 Aug. 1967, *L. Henshall* 164 (NT).

*Selected rugose-leaved specimens examined.* SOUTH AUSTRALIA: Middle River, NW Kangaroo Island, Oct. 1905?, *E. Ashby s.n.* (NSW 122886); Stokes Bay, Kangaroo Island, 19 July 1933, *A.B. Cashmore s.n.* (AD); top of cliff, E of Cape Borda, Dec. 1968, *J.B. Kirkpatrick s.n.* (AD); Cape Borda, Kangaroo Island, 29 Aug. 1964, *M.E. Phillips* 418 (NT).

*Selected specimens of var. pentamera examined.* SOUTH AUSTRALIA: Hawk's Nest Stn, June 1932, *Anon. s.n.* (ADW 1737); near Kelly's Hill Caves, South Coast Rd, c. 15 km ENE of Cape du Couedic,

20 Sep. 1957, *J.B. Cleland s.n.* (AD); 5 mi. [8 km] from American River to Kingscote, 9 July 1964, *H.M. Cooper s.n.* (AD); South Coast Rd, near Mr Dave Schaeffer's property, 27 June 1963, *G. Jackson* 248 (AD); Mt Thisby Rd, 400 yd [0.4 km] E of Salt Lakes turnoff, 14 July 1963, *G. Jackson* 263 (AD); near Destrees Bay, Kangaroo Island, 30 Aug. 1964, *M.E. Phillips* 472 (BRI, CBG); Avery's Lagoon, c. 13 km SW of American River, 25 Sep. 1965, *M.E. Phillips s.n.* (CBG).

*Distribution and habitat.* Occurs in south-eastern Australia, extending from Eyre Peninsula and Kangaroo Island in South Australia east to the lower Darling and Murrumbidgee Rivers area of New South Wales and the Ballarat area of Victoria (Figure 9B). It is recorded mainly on dunes or sandplains with mallee scrub, in a fairly dry climatic zone.

*Rinzia ericaea* occurs entirely within the much wider distribution of *R. orientalis*, and occasionally the two species occur in close proximity, for example in Wyperfeld National Park, Victoria. Specimens collected there in early October differed in their phenology, with *R. orientalis* (*A.C. Beauglehole & E.W. Finck* 29095a) in fruit while *R. ericaea* (*A.C. Beauglehole & E.W. Finck* 29095b) was in bud and flower. Differences in flowering time may contribute to the reproductive isolation of these two taxa, but their overall flowering periods appear to be similar based on the collections examined. The October fruiting time may be atypical for *R. orientalis* as Bonney and Miles (1994) record January to March as the best period for harvesting its seeds.

*Phenology.* Flowers and fruits mostly recorded from August to November.

*Conservation status.* This is the most widespread and common species in the genus and it is not considered to be under threat.

*Etymology.* The oldest available epithet cannot be used when transferring this species to *Rinzia*, as it is predated by *R. crassifolia* Turcz. The new epithet reflects the fact that *R. orientalis* extends further east than any other member of the genus.

*Common name.* Desert Heath-myrtle. This species has also been known as Desert Baeckea, but that name is no longer appropriate now that the species is included in *Rinzia*.

*Typification.* For *B. crassifolia*, the collector and number are *T.L. Mitchell* 194 according to the CGE sheet presumed to be the holotype, whereas the K sheet has no collector's number and the MEL sheet gives the number as 164, but does not name the collector. As there were two collectors on the expedition, T.L. Mitchell and J.M. Richardson (Barker & Barker 1990), it is not certain that Mitchell was the sole collector of this material. Only the MEL sheet gives full details of the locality and date (given in square brackets above).

AD 97642077 has two specimens; the one on the left is labelled as the holotype of var. *pentamera* and is accompanied by notes and illustrations showing that it has only five stamens. The specimen on the right (*E.C. Black s.n.*) is from 83 miles [c. 135 km] north of Port Lincoln and is also accompanied by notes and illustrations indicating that there are only five stamens. As the latter specimen is the only five-staminate one examined in the current study that is reported to come from the mainland, its collection details need confirmation.

*Variation in vegetative characters.* Leaves vary considerably, much of the variation being related to the habitat occupied and seasonal effects. Specimens with the smallest leaves sometimes have them

almost elliptic in cross-section, with both the adaxial and abaxial surfaces convex. However, it is much more common for the abaxial surface to be much deeper than the adaxial one, which then tends to be flat or concave. Small-leaved specimens are common in all areas except for the northern part of the western third of the species' range; this area, from Gawler Ranges east to Flinders Range, has a long-leaved variant, including a specimen from south-west of Port Augusta (*G. Gardiner s.n.*, cited above) with leaves up to 6 mm long. Long-leaved specimens are also recorded through much of the remainder of the species' range, although they are less common than short-leaved specimens.

There is a concentration of specimens (some cited above) with markedly rugose leaves along the northern coast of Kangaroo Island. These specimens have more prominent oil glands than all or almost all of the mainland specimens. On the mainland, specimens with oil glands that are more prominent than usual, e.g. *J. Carrick* 3389, are scattered through the distribution.

Occasional oddities include a CBG specimen (*M.E. Phillips* 57) on which one branchlet has leaves in whorls of three rather than opposite-decussate.

*Variation in floral characters.* A variant on the south coast of Kangaroo Island, mainly in the area south of Kingscote (see Figure 9B), has most flowers with only five stamens; this has been named var. *pentamera*. Variation in stamen number on Kangaroo Island shows the full range from five to ten, but is almost completely constant at ten stamens on the mainland, the only notable deviation from ten being in two specimens, *J. Cullimore* 25 and *L. Henshall* 164, from near Red Cliffs in far north-west Victoria (see Figure 9B), that have 11–13 stamens in most flowers, with a spaced pair of short stamens opposite one to three of the sepals and with a single stamen directly opposite the remaining sepals.

Variety *pentamera* was described as having only five stamens (Black 1935), but most or all specimens of this variant have some flowers with higher numbers of six or more. This suggests that it is not worth retaining as a named variety, although it appears to be fully or largely geographically separated from specimens with uniformly ten stamens on the island.

Style length is very variable, ranging from 0.8 mm (e.g. *C.R. Alcock* 5955), or possibly down to 0.6 mm long, to at least 2.2 mm long at maturity.

*Notes.* Earlier descriptions of this taxon are given in Trudgen (1986b), Jeanes (1996) and Wilson (2002). Further study of the considerable variation in *R. orientalis* might reveal discontinuities that are worthy of recognition at some level. Four of its variants discussed above are either very geographically restricted, or have a definite area of concentration, within the overall range. For those variants specimens are cited above.

Other mainland variants seem to be more widely dispersed and need further study to determine whether they are associated with specific habitats or seasonal fluctuations etc.

In a number of morphological characters, *R. orientalis* shows a greater similarity to the Western Australian species *R. icosandra* than to the eastern species *R. ericaea*. This may be a result more of the odd morphological specialisations shown by *R. ericaea* than of actual genetic distance between the taxa, since both the chloroplast and nuclear molecular data (Lam *et al.* 2002; Peter Wilson pers. comm.) indicate a much greater affinity between the two eastern taxa than either has to the western species. The opportunity for physical contact between the eastern taxa might have allowed hybridisation and some degree of genetic exchange between them in the past.

*Rinzia orientalis* differs from both of the other species in its section in that its bracteoles are shed from the young buds and are smaller than in either of the other two taxa. See also the discussion of distinguishing features under *R. ericaea* and *R. icosandra*.

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**Five new species of *Styphelia* (Ericaceae: Epacridoideae: Stypheliaceae) from the Geraldton Sandplains, including notes on a new, expanded circumscription for the genus**

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**Abstract**

Hislop, M. & Puente-Lelièvre, C. Five new species of *Styphelia* (Ericaceae: Epacridoideae: Stypheliaceae) from the Geraldton Sandplains, including notes on a new, expanded circumscription for the genus. *Nuytsia* 28: 95–114 (2017). Five new species of *Styphelia* Sm. (*S. ciliosa* Hislop & Puente-Lel., *S. filamentosa* Hislop & Puente-Lel., *S. filifolia* Hislop & Puente-Lel., *S. longissima* Hislop & Puente-Lel. and *S. williamsiorum* Hislop & Puente-Lel.) are described, illustrated and mapped. All were previously recognised by phrase names under *Leucopogon* R.Br., and occur in the Lesueur Sandplain subregion of the Geraldton Sandplains bioregion. There is discussion of the recent decision to greatly expand the circumscription of *Styphelia* to include the genera *Coleanthera* Stschegl., *Croninia* J.M.Powell, most species of *Astroloma* R.Br. and a large percentage of those previously treated as *Leucopogon*.

**Introduction**

Recently published research by Puente-Lelièvre (2013) and Puente-Lelièvre *et al.* (2016) dealing with the molecular phylogeny of the *Styphelia* Sm.–*Astroloma* R.Br. clade and associated taxonomic implications, has foreshadowed a new, much-expanded circumscription for the genus *Styphelia*. What this change will mean for the Western Australian epacrid flora is that all taxa currently assigned to *Astroloma* (27 taxa, excluding *A. sp. Grass Patch* (A.J.G. Wilson 110), which is to be described as a species of *Stenanthera* R.Br.), *Coleanthera* Stschegl. (3) and *Croninia* J.M.Powell (1), will be transferred to *Styphelia*. Joining them there will be 108 taxa currently placed in *Leucopogon* R.Br., which represents approximately one half of the state's total for that genus. A forthcoming paper will formalise the transfer of all of the previously described species to *Styphelia*. As a consequence of these changes, whereas *Leucopogon* had previously been by far the largest epacrid genus in Western Australia, *Styphelia* will now assume that status.

The species treated in this paper are the first described under a re-classified *Styphelia* and all had previously been recognised as phrase names under *Leucopogon*. They are morphologically diverse and belong to several of the taxonomic groups delineated by Puente-Lelièvre *et al.* (2016). Their relationships within the new taxonomic framework will be discussed below on a species-by-species

basis. All occur in the Lesueur Sandplain subregion of the Geraldton Sandplains bioregion, with two extending south into the Swan Coastal Plain bioregion. Iluka Resources, the sponsors of this project, nominated the species described here as being among those most relevant to their operations.

### Notes on the new circumscription of *Styphelia*

Since Bentham's (1868) treatment of the genus, it has been recognised that *Leucopogon* can be broadly divided into two groups: essentially those with the combined characters of terminal inflorescences and sterile anther tips, and those with axillary inflorescences and anthers lacking sterile tips. Sleumer's (1963) lectotypification of the genus on *L. lanceolatus* (Sm.) R.Br. confirmed that it was the former group that represented *Leucopogon s. str.* in the event of any future splitting of the genus.

A series of studies into relationships within the tribe Styphelieae Bartl. progressively strengthened the case that these two elements could not be regarded as congeneric (Powell *et al.* 1997; Taaffe *et al.* 2001; Quinn *et al.* 2003). In a combined analysis of DNA sequence data from two genomic regions of the chloroplast (the *matK* and *atpB-rbcL* intergenic spacer), Quinn *et al.* (2003) produced a phylogenetic tree which grouped those species of *Leucopogon* with axillary inflorescences in a large clade with *Styphelia*, *Astroloma* and the small genera *Coleanthera* and *Croninia*. Those species of *Leucopogon* with terminal inflorescences and sterile anther tips grouped together in a separate clade, thus corroborating the monophyly of *Leucopogon s. str.* While support for the *Styphelia*–*Astroloma* clade as a whole was strong, relationships within the clade were inadequately resolved and the need for further research was recognised before any revised classification could be finalised.

The recently concluded study (Puente-Lelièvre 2013; Puente-Lelièvre *et al.* 2016) was therefore a targeted response to the challenge of delimiting genera that were both phylogenetically-based and had morphological integrity. With sequence data for 207 taxa utilising four chloroplast markers (*rbcL*, *matK*, *trnH-psbA* and *atpB-rbcL*) and one nuclear region (ITS), the molecular scope of the latest research was significantly larger than in earlier studies. Parsimony and Bayesian analyses of these data yielded a phylogenetic tree showing 12 generally well-supported lineages. However, while most of these could either be diagnosed by the presence of a unique morphological feature or by a combination of characters, for a minority of lineages corresponding unique, morphological features or character combinations could not be identified.

This left the authors with a difficult taxonomic decision: either to accept at least 12 genera, some of which would lack a ready means of morphological diagnosis, or to greatly expand the circumscription of *Styphelia* so as to include all of these elements. The former option had the advantage of better reflecting the morphological and molecular diversity of the group, but with the clear problem of an absence of unique morphological features or character combinations by which to recognise some of the potential generic groups. The single genus option would result in a polymorphic assemblage (that would not itself be readily diagnosable) but one that would be strongly supported by the molecular data and would have a greater likelihood of providing taxonomic stability. Ultimately the latter consideration prevailed and the decision to recognise a greatly enlarged *Styphelia* was taken.

### Methods

This study was based on an examination of dried specimens housed at PERTH, together with field observations of the species described and their relatives in Western Australia.

Foliar measurements and observations were taken from dried specimens. Care was taken to confine observations to mature leaves. Inflorescence length was measured from the point of attachment at the axil to the tip of the bud-rudiment or (sometimes in *S. ciliosa* Hislop & Puente-Lel.) to the flower base if the bud-rudiment was lacking. Floral measurements were taken from rehydrated flowers in natural posture, with the exception of the corolla lobes which were uncurled to their fullest length before measuring. Fruit length is inclusive of a gynophore, if present.

Bioregions and subregions referred to in the text and shown on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

### Taxonomy

#### ***Styphelia ciliosa* Hislop & Puente-Lel., *sp. nov.***

*Typus*: eastern boundary of Moore River National Park, 4.5 km north of the south-east corner of park, Western Australia, 27 September 1999, *M. Hislop* 1695 (*holo*: PERTH 05406013; *iso*: CANB, MEL, NSW).

*Leucopogon* sp. Moore River (M. Hislop 1695), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 12 February 2016]

Usually erect *shrubs* to c. 150 cm high and 150 cm wide, but occasionally low and spreading, from a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of patent hairs, mostly <0.08 mm but occasionally to 0.20 mm long. *Leaves* helically arranged, variably orientated, usually rather steeply antrorse but occasionally with some leaves shallowly antrorse to retrorse, narrowly elliptic, narrowly ovate-elliptic or narrowly obovate-elliptic (usually the leaves variably shaped on the same plant), 3.5–9.0 mm long, 1.0–2.2 mm wide; petiole 0.3–0.8 mm long, hairy throughout or at least on the adaxial surface; base attenuate to  $\pm$  cuneate; apex obtuse to acute, with a blunt callus tip; lamina with a variable curvature, usually adaxially concave, less often flat to adaxially convex, the longitudinal axis gently recurved to gently incurved; surfaces slightly discolourous, shiny; adaxial surface glabrous except sometimes for a few hairs towards the base, the venation not evident; abaxial surface slightly paler, glabrous, with 5–7 usually raised primary veins, with open to  $\pm$  closed grooves between, occasionally the veins  $\pm$  flat; margins glabrous or coarsely and minutely ciliate. *Inflorescence* axillary, erect; axis 0.6–1.8 mm long, 2- or less often 1-flowered,  $\pm$  terete, terminating in a bud-rudiment if 2-flowered, bud-rudiment lacking if 1-flowered; axis indumentum dense, to c. 0.1 mm long; flowers erect, pedicellate above the bracteoles, the pedicels 0.3–0.7 mm long. *Fertile bracts* ovate or narrowly ovate, 0.7–1.0 mm long, 0.4–0.5 mm wide, broadly ovate, present in 2-flowered inflorescences, usually absent in 1-flowered inflorescences, sterile bracts absent. *Bracteoles* ovate, 0.5–1.1 mm long, 0.4–0.5 mm wide, acute or subacute; abaxial surface keeled, greenish, usually hairy, at least about the lower keel; margins ciliate. *Sepals* narrowly ovate, 1.4–1.8 mm long, 0.4–0.6 mm wide, acute, not mucronate; abaxial surface usually glabrous, rarely sparsely hairy, pale greenish to straw-coloured, venation prominent; margins ciliate with hairs 0.1–0.2 mm long. *Corolla tube* white, narrowly ellipsoid to narrowly obovoid, much longer than the sepals, 2.0–2.7 mm long, 0.9–1.5 mm wide, glabrous externally, internal surface hairy below the lobes, the hairs often extending as far as the base of the anthers. *Corolla lobes* white, slightly shorter than, to slightly longer than the tube, erect in lower 1/3–1/2 and then spreading and recurved, 1.8–2.7 mm long, 0.5–0.6 mm wide at base; external surface usually glabrous, rarely sparsely hairy; internal surface with a dense indumentum of twisted and ornamented hairs, the hairs shorter towards the base. *Anthers* partially exserted from the

tube (by  $1/3$ – $1/2$  of their length), 0.6–1.0 mm long, apex emarginate, the base minutely apiculate. *Filaments* terete, *c.* 0.2 mm long, attached to anther  $2/3$ – $3/4$  above anther base, adnate to tube just below sinuses. *Ovary* pale yellow-brown, narrowly ovate in outline, compressed, 0.7–1.0 mm long, 0.3–0.5 mm wide, glabrous, rarely sparsely hairy, 2-locular. *Style* minutely scabrous in upper half, glabrous below, (1.8–)2.0–2.5 mm long, arising from a depression at ovary apex (the base tightly enveloped by ovarian tissue), exerted from corolla tube to a point  $\pm$  at the same level as the erect bases of the corolla lobes; stigma greatly expanded. *Nectary* partite, the scales 0.35–0.50 mm long, 0.2–0.3 mm wide, long-ciliate, otherwise glabrous, or rarely the abaxial surface hairy. *Fruit* much longer than the sepals, 3.5–5.0 mm long (inclusive of gynophore), 1.2–1.5 mm wide, narrowly elliptic to narrowly obovate, strongly compressed (linear to very narrowly elliptic in T.S.) and leaf-like, with a long, glabrous gynophore (slightly shorter than, to slightly longer than, the sepals); surface glabrous, dry, with 3–5 raised longitudinal veins; the style early-deciduous. (Figure 1)

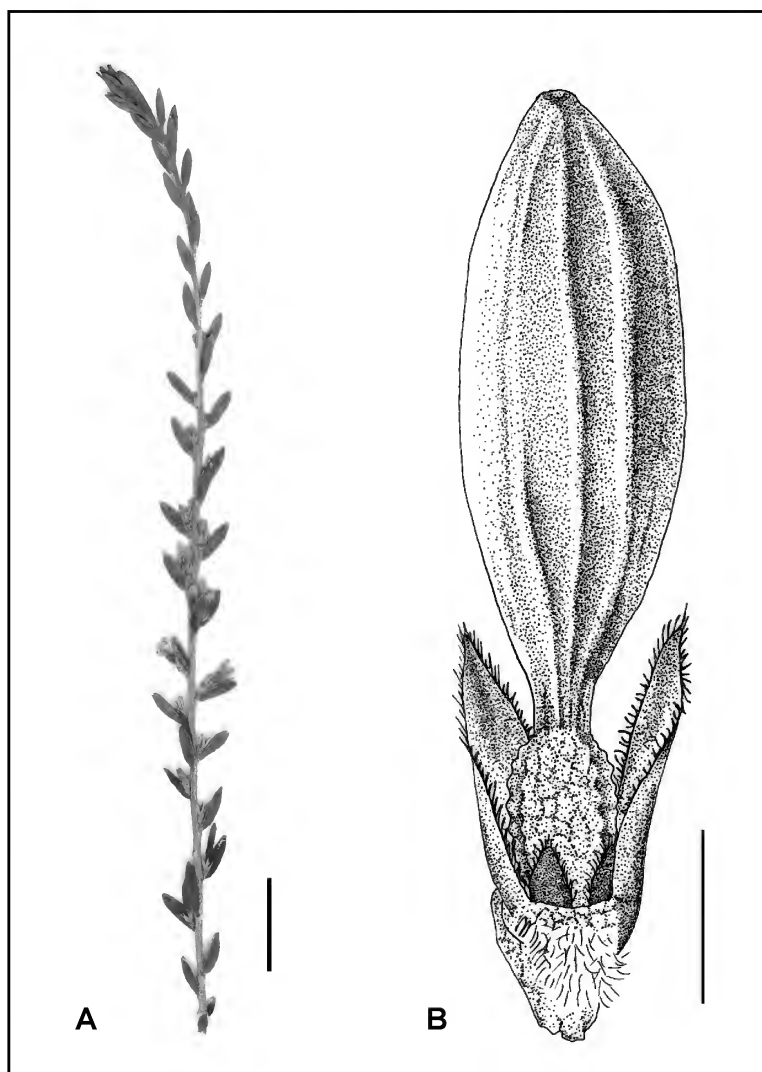


Figure 1. *Styphelia ciliosa*. A – photograph of flowering branchlet from *F. Hort* 874; B – fruit. Scale bars = 1 cm (A), 1 mm (B). Drawn by Skye Coffey from *B.J. Keighery* & *N. Gibson* 164 (B).

*Diagnostic characters.* Distinguished from all other *Styphelia* by the combination of strongly compressed and leaf-like fruit with a glabrous gynophore, innocuous leaf apices and a partite nectary with long-ciliate scales.

*Other specimens examined.* WESTERN AUSTRALIA: Nambeelup Rd [E of Mandurah], 16 Nov. 1992, *R. Fairman* 11/93 (PERTH); Gnangara Mound [c. 8 km NW of Muchea], 28 Nov. 2002, *C. Gray* 159-03 (PERTH); truck-stop W side of Brand Hwy, 5.7 km N of the SE corner of Moore River National Park, 22 Oct. 1999, *M. Hislop* 1705 (CANB, MEL, NSW, PERTH); on firebreak running N–S c. 150 m NE of the High Hill corner of Badgingarra National Park, 6 Dec. 1999, *M. Hislop* 1941 (CANB, NSW, PERTH); private property, to SE of powerlines off Elliott Rd, 700 m E of Yangedi Rd, W of Keysbrook, 2 Dec. 2001, *M. Hislop* 2488 (CANB, NSW, PERTH); Brand Hwy, Moore River National Park, Gingin: 0.8 km N of Marri Heights Rd, 8 Dec. 1999, *F. & J. Hort* 852 (CANB, K, MEL, PERTH); Moore River National Park, Gingin: take Nine Mile Swamp Rd for 9.85 km W of Beermullah Rd, 12 Dec. 1999, *F. Hort, J. Hort & J. Tonkin* 853 (CANB, PERTH, NSW); Moore River National Park, Brand Hwy: 1.9 km S of Marri Heights Rd, then track W for 1.9 km, 21 Dec. 1999, *F. Hort* 874 (K, NSW, PERTH); Boonanarring Nature Reserve, Gingin: 7.2 km E of Brand Hwy on Wannamal West Rd then tracks S for 0.7 km and SE-E for 0.4 km, 20 Nov. 2001, *F. Hort* 1655 (K, MEL, NSW, PERTH); S side of Namming Nature Reserve, on N side of Hunter Rd, 5 km W of Brand Hwy, 10 Sep. 1988, *B.J. Keighery* 210B (PERTH); along Muchea–Eneabba powerline, 11 km SSE of Gingin airfield, 21 Oct. 1993, *B.J. Keighery & N. Gibson* 164 (PERTH); Eneabba [S part of Eneabba Nature Reserve], 27 Sep. 2007, *B. Taylor & C. Anderson* P2–42–02 (PERTH); on crest, 10.3 km W of Brand Hwy on Orange Springs Rd, 15 Nov. 1999, *M. Trudgen, R. Archer & M. Wood* MET 20440 (PERTH).

*Distribution and habitat.* Has a scattered distribution in the Geraldton Sandplains and Swan Coastal Plain bioregions, from the Warradarge area to Keysbrook (Figure 2). The two northern populations near Warradarge and Badgingarra, and those around Keysbrook in the south, are apparently disjunct. Almost all records are from sandy soils on the coastal plain and in association with *Banksia* woodland.

*Phenology.* Apparently has a lengthy flowering period, probably peaking between September and November. Most collections, even those from early September, have some more or less mature fruit present.

*Etymology.* From the Latin *cilium* (a fine hair), and *-osus* (indicating marked development), a reference to the ciliate nectary scales of this species.

*Conservation status.* *Styphelia ciliosa* is common in Moore River National Park and is also known from Namming and Boonanarring Nature Reserves. The two disjunct, northern populations are in Badgingarra National Park and South Eneabba Nature Reserve, while the southern variant (discussed under Notes below) is currently known from just two populations on private property. No conservation coding.

*Affinities.* This species is a member of the small Group XI (*sensu* Puente-Lelièvre *et al.* 2016), which comprises another two described species (*Leucopogon blepharolepis* (F. Muell.) Benth. and *L. flavescens* Sond.) and two more phrase-named taxa. A remarkable feature of the group is the strongly compressed, prominently veined and leaf-like fruit, which are quite unlike those of any other *Styphelia*. *Styphelia ciliosa* is the only member of Group XI that occurs in either the Geraldton Sandplains or Swan Coastal Plain bioregions and for that reason should not be confused with other members of the genus growing in those areas.

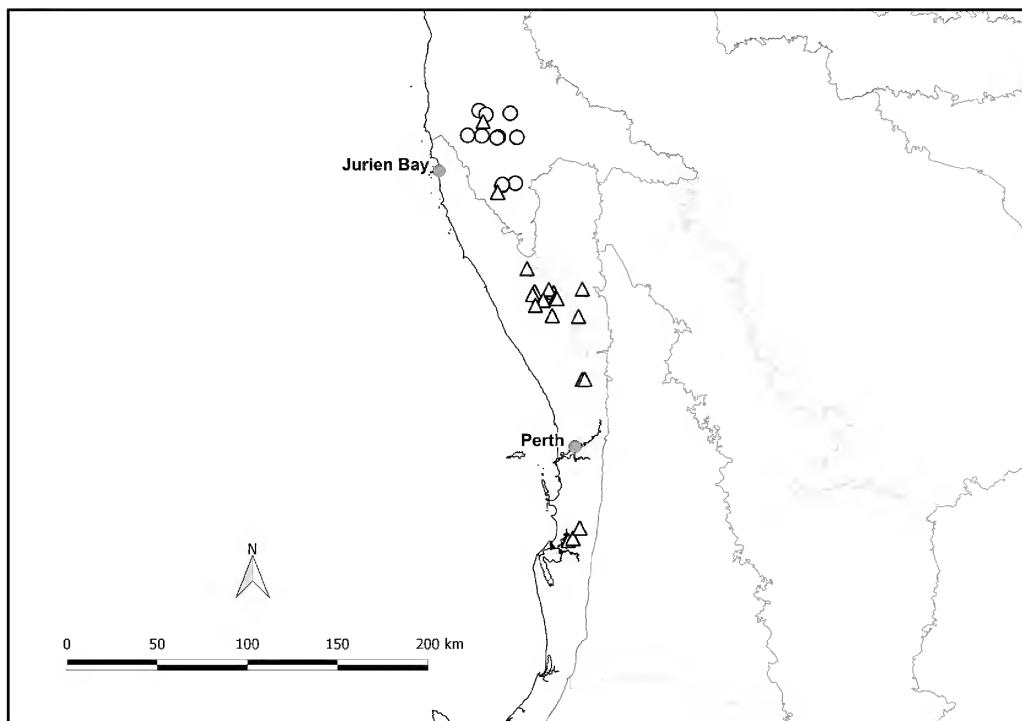


Figure 2. Distribution of *Styphelia ciliosa* (△) and *S. filamentosa* (○) in Western Australia.

In gross morphology the new species is most similar to the variable *L. flavescens*, which is distributed between Albany and Fitzgerald River National Park and inland as far as the Stirling Range. The two are most easily distinguished by the presence in *S. ciliosa* of long cilia on the nectary scales, in contrast to the glabrous scales of *L. flavescens*. It also differs in its smaller fruit (3.5–5.0 mm long, 1.2–1.5 mm wide compared to 4.5–6.4 mm long, 1.5–2.6 mm wide in *L. flavescens*) with a glabrous rather than hairy gynophore. An additional floral distinction between the two relates to the anthers, which in *S. ciliosa* have an emarginate apex and a more or less narrowed and minutely apiculate base, whereas in *L. flavescens* they are emarginate at both ends. Note that the difference in fruit size, given above, does not apply to the disjunct eastern populations of *L. flavescens* (i.e. var. *brevifolius* Benth.), which have smaller fruits than the typical variety but which are easily distinguished from *S. ciliosa* by their very thick, and densely arranged leaves.

One other member of Group XI, *L. blepharolepis* (distributed from NE of Mount Barker to Stokes National Park) also has ciliate nectary scales. That species, however, is easily distinguished from *S. ciliosa* by its long-mucronate, pungent leaves and much longer inflorescences which are always more than 2-flowered. The long-ciliate nectary scales of *L. blepharolepis* and *S. ciliosa* are unusual and not seen anywhere else in the Western Australian Stypheliaceae.

*Notes.* Relative to the typical form of the species, which is an erect shrub up to about 150 cm high, plants from the southern populations have a low, compact growth habit, to about 30 cm high and 40 cm wide. They also have a tendency towards more spreading leaves (from shallowly antrorse to strongly retrorse), whereas the typical form generally has most leaves steeply antrorse and if patent to retrorse hairs are present they are relatively few and towards the base of the branches.

The material from Badgingarra differs from the typical form of the species in having hairs on the sepals, ovary and external surface of the corolla lobes. Absence or presence of an indumentum on these surfaces (in particular the latter two) is often taxonomically significant in the *Styphelieae*.

The question of whether to recognise segregate taxa from within the current circumscription of *S. ciliosa* will need to be revisited when Group XI is treated in its entirety.

***Styphelia filamentosa* Hislop & Puente-Lel., *sp. nov.***

*Typus*: Alexander Morrison National Park, Western Australia [precise locality withheld for conservation reasons], 17 November 2008, *M. Hislop* 3866 (*holo*: PERTH 08182078; *iso*: CANB, MEL).

*Leucopogon* sp. Bifid Eneabba (M. Hislop 1927), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 12 February 2016]

Low, compact, spreading *shrubs*, to c. 30 cm high and 50 cm wide, from a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of very short hairs, <0.05 mm long. *Leaves* helically arranged, antrorse, usually steeply so, narrowly ovate to narrowly elliptic, 5–11 mm long, 1.2–2.0 mm wide; petiole 0.3–0.6 mm long, glabrous or minutely and sparsely hairy; base attenuate to cuneate; apex long-mucronate, pungent, the mucro 0.4–0.7 mm long; lamina flat or concave adaxially, the longitudinal axis straight to gently incurved, usually distinctly twisted; surfaces glabrous, strongly discolorous; adaxial surface shiny (initially  $\pm$  glaucous but soon abraded), dark green, venation not evident; abaxial surface much paler, matt, faintly striate to  $\pm$  smooth, with 5–7 primary veins; margins shortly and coarsely ciliolate with antrorse hairs <0.05 mm long. *Inflorescence* axillary, pendulous; axis 2.0–4.2 mm long, 1–3(–4)-flowered, the fertile upper portion angular or shortly winged, terminating in a bud-rudiment; axis indumentum sparse, to c. 0.1 mm long; flowers pendulous, subsessile to shortly pedicellate below the bracteoles, with a pedicel to 0.5 mm long. *Fertile bracts* broadly ovate to  $\pm$  orbicular, 0.4–1.0 mm long, 0.4–1.0 mm wide, with 2–4 variously shaped, sterile bracts. *Bracteoles* depressed-ovate, broadly ovate to  $\pm$  orbicular, 1.0–1.7 mm long, 1.2–1.4 mm wide, obtuse, shortly mucronate; abaxial surface glabrous, green, striate; margins minutely ciliolate or  $\pm$  glabrous. *Sepals* narrowly ovate, 2.5–3.2 mm long, 1.0–1.2 mm wide, acute, usually mucronate; abaxial surface glabrous, pale green or straw-coloured, venation rather inconspicuous; margins minutely ciliolate towards the apex, and sometimes also about the base. *Corolla tube* white, campanulate, much shorter than the sepals, 1.2–1.8 mm long, 1.2–1.6 mm wide, glabrous externally and internally. *Corolla lobes* white, longer than the tube, erect in lower 1/3–1/2 and then spreading and  $\pm$  recurved, 2.3–2.8 mm long, 0.5–0.8 mm wide at base; external surface glabrous; internal surface with a sparse to moderately dense indumentum (often very sparse towards the base) of flat, twisted hairs, not or barely ornamented. *Anthers* partially exserted from the tube (by c. 7/8 of their length), 1.7–2.3 mm long, apex deeply bifid, with filiform, crinkled lobes 0.7–1.1 mm long, the base asymmetric, barely notched. *Filaments* terete, 0.4–0.5 mm long, adnate to tube just below sinuses, attached to anther 1/4–1/3 above base. *Ovary* pale green, ellipsoid or narrowly so, 0.6–0.9 mm long, 0.4–0.5 mm wide, with a moderately dense indumentum of hairs 0.1–0.3 mm long, 2-locular. *Style* glabrous, 2.5–3.2 mm long, arising from a depression at ovary apex (the base enveloped by ovarian tissue), well-exserted from corolla tube to a point a little beyond the erect bases of the corolla lobes; stigma not expanded. *Nectary* partite, the scales 0.4–0.8 mm long, 0.3–0.4 mm wide, glabrous. *Fruit* a little shorter than, to a little longer than, the sepals, narrowly ellipsoid to  $\pm$  cylindrical, 2.1–2.5 mm long, 0.9–1.1 mm wide,  $\pm$  circular in section; surface hairy with a spreading indumentum, smooth (mesocarp poorly developed) apart from obscure, longitudinal ribs; apex rounded, the style shed at, or close to, maturity. (Figures 3, 4)



Figure 3. *Styphelia filamentosa*. Photograph of flowering branchlet from M. Hislop 3866. Scale bar = 1 cm.

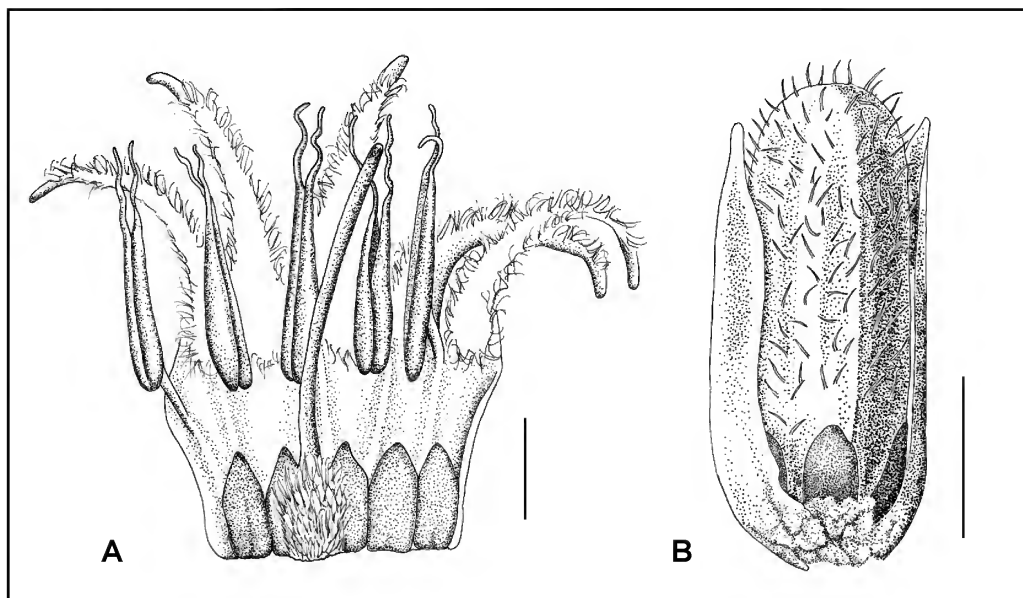


Figure 4. *Styphelia filamentosa*. A – flower, slit open longitudinally; B – fruit. Scale bars = 0.5 mm (A), 1 mm (B). Drawn by Skye Coffey from M. Hislop 3866 (A); M. Hislop 671 (B).

*Diagnostic characters.* This species is distinguished from all other *Styphelia* by the following character combination: pendulous inflorescence, pungent, narrowly ovate or narrowly elliptic, longitudinally twisted leaves, a partite nectary and deeply bifid anthers with filiform, crinkled lobes.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 9 Oct. 1978, *R.J. Cranfield* 834 (PERTH); 4 Oct. 2003, *D.M. Crayn* 640, *K. Lemson* & *K.A. Kron* (NSW, PERTH); 29 Oct. 1966, *A.S. George* 8632 (CANB, NSW, PERTH); 31 May 1978, *E.A. Griffin* 1012 (PERTH); 26 Oct. 1978, *E.A. Griffin* 1304 (PERTH); 15 Dec. 1996, *M. Hislop* 671 (PERTH); 6 Dec. 1999, *M. Hislop* 1927 (CANB, PERTH); 13 Nov. 2004, *M. Hislop* 3348 (CANB, PERTH); 8 Oct. 1993, *P.C. Jobson* 2288 (MEL, PERTH); 23 Mar. 2007, *V. Westcott* SD 49 (PERTH).

*Distribution and habitat.* Endemic to the Geraldton Sandplains bioregion between Eneabba and Coomallo Nature Reserve, east of Jurien Bay (Figure 2). Grows on deep, white sand or sand over laterite, in the understorey of species-rich heath. Unlike some of its relatives in the *L. conostephioides* DC. complex this species does not favour gravelly soils where laterite is at, or very close to, the surface.

*Phenology.* The main flowering period appears to be between October and December, however, a couple of flowering collections have been made in the autumn months. Mature fruit, as well as flowers, is present on specimens collected in November, December and March.

The flowering pattern described above is an unusual one within the *L. conostephioides* complex. Most members of this group come into flower in the autumn and continue until mid-winter (i.e. between about April and July). However, the phenomenon of producing a flush of flowering in late spring and then again after the first rains of autumn is also seen in some species of *Leucopogon* s. str. from the Geraldton Sandplains.

*Etymology.* From the Latin *filamentum* (thread) and *-osus* (abounding in), a reference to the very fine, thread-like lobes of the deeply bifid anthers.

*Conservation status.* Recently listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian flora under the name *Leucopogon* sp. Bifid Eneabba (*M. Hislop* 1927) (Western Australian Herbarium 1998–). *Styphelia filamentosa* is often locally common within its restricted distribution. It is currently known to occur in one national park and three nature reserves.

*Affinities.* A member of the *L. conostephioides* group or Group VIII (*sensu* Puente-Lelièvre *et al.* 2016). This group comprises another four described species (*L. conostephioides*, *L. hispidus* E.Pritz., *L. pubescens* S.Moore and *L. rigidus* DC.) as well as at least seven that are currently undescribed and recognised by phrase-names under *Leucopogon*. The group reaches its greatest diversity in the Geraldton Sandplains, with all but two member taxa occurring there and five endemic to that bioregion.

*Styphelia filamentosa* (as *L.* sp. Bifid Eneabba) was one of seven taxa from Group VIII included in the molecular phylogenetic analysis of Puente-Lelièvre *et al.* (2016), and was placed in a basal position as sister to the other six. In terms of its morphology the species is readily distinguished from all other members of the group (and all other Western Australian *Styphelia*) by the deeply bifid anthers with crinkled lobes and longitudinally twisted leaves.

**Styphelia filifolia** Hislop & Puente-Lel., *sp. nov.*

*Typus*: Murdoch, Western Australia [precise locality withheld for conservation reasons], 6 May 2001, M. Hislop 2209 (*holo*: PERTH 05791057; *iso*: CANB, MEL, NSW).

*Leucopogon* sp. Murdoch (M. Hislop 1037), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 12 February 2016]

Erect *shrubs* to c. 90 cm high and 70 cm wide, from a fire-sensitive rootstock. Young *branchlets* glabrous or occasionally with an irregular, sparse indumentum of patent hairs, <0.05 mm long. *Leaves* helically arranged, variously antrorse to shallowly retrorse, mostly linear, occasionally very narrowly ovate, 12–27 mm long, 0.6–2.2 mm wide; petiole 0.4–1.2 mm long, glabrous or with sparse adaxial hairs; base attenuate to  $\pm$  cuneate; apex mucronate, the mucro innocuous, 0.2–0.5 mm long; lamina adaxially convex with strongly recurved to revolute margins, the longitudinal axis straight or gently recurved (rarely gently incurved); surfaces slightly discolorous; adaxial surface glabrous, shiny, smooth to finely scabrous with 3–5 sunken lines; abaxial surface (where visible) paler, glabrous, matt,  $\pm$  smooth to faintly striate with 5–7 primary veins; margins glabrous, although usually obscured by recurved lamina. *Inflorescence* axillary, pendulous; axis 1.2–4.2 mm long, 1–4-flowered, glabrous,  $\pm$  terete, terminating in a bud-rudiment; flowers pendulous, pedicellate below the bracteoles, the pedicel 0.7–1.2 mm long. *Fertile bracts* ovate, 0.8–1.2 mm long, 0.7–0.8 mm wide, subtended by 2 or 3 sterile bracts. *Bracteoles* depressed-ovate to transversely elliptic, 1.0–1.3 mm long, 1.2–1.7 mm wide, obtuse; abaxial surface glabrous, green, obscurely striate; margins minutely ciliolate. *Sepals* ovate or narrowly ovate, 2.0–3.0 mm long, 1.0–1.5 mm wide, obtuse; abaxial surface glabrous, minutely verrucose and transversely ridged, pale greenish to straw-coloured, venation obscure; margins minutely ciliolate to  $\pm$  glabrous. *Corolla tube* white, campanulate or broadly campanulate, slightly shorter than, to a little longer than, the sepals, 1.7–2.5 mm long, 1.7–2.4 mm wide, glabrous externally and internally. *Corolla lobes* white, abaxially concave, longer than the tube, erect in lower 2/3–3/4 and then spreading and  $\pm$  recurved, 2.5–3.5 mm long, 1.0–1.5 mm wide at base; external surface glabrous; internal surface with a dense indumentum of twisted, flat and  $\pm$  terete, variably ornamented hairs. *Anthers* fully exerted from the tube, but not exerted beyond the erect, basal portion of the corolla lobes, 1.0–1.7 mm long, apex emarginate. *Filaments*  $\pm$  laterally compressed towards the base, terete above, 0.8–1.3 mm long, adnate to tube just below sinuses, attached to anther c. 1/2 above base. *Ovary* very dark green to almost black, ovoid, (0.8–)1.2–1.5 mm long, 0.6–0.8 mm wide, glabrous, 5-locular. *Style* minutely scabrous in the upper half, glabrous below, or glabrous throughout, 2.5–3.8 mm long, tapering smoothly from ovary apex, well-exserted from corolla tube to a point beyond the erect bases of the corolla lobes; stigma distinctly expanded. *Nectary* annular, but deeply lobed and longitudinally grooved below the sinuses so as to sometimes appear partite, 0.5–1.0 mm long, glabrous, the lobes acute and often irregularly toothed. *Fruit* much longer than the sepals, strongly zygomorphic, 4.8–8.0 mm long, 4.0–6.8 mm wide, bilaterally compressed, the style base excentric, displaced onto the adaxial edge of the drupe; surface glabrous, deeply rugose (mesocarp well-developed, fleshy at maturity); apex rounded, the style usually persistent to maturity. (Figure 5)

*Diagnostic characters.* Distinguished from all other *Styphelia* by the combination of pendulous inflorescences, linear or very narrowly ovate leaves with a mucronate, but innocuous apex, and a strongly zygomorphic fruit.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 May 1996, R. Davis RD 859 (NSW, PERTH); 9 Mar. 1979, J. Dodd 35 (PERTH); 21 Mar. 1981, E.A. Griffin & M.I. Blackwell EAG 3090 (PERTH); 21 Mar. 1999, M. Hislop 1276 (NSW, PERTH);

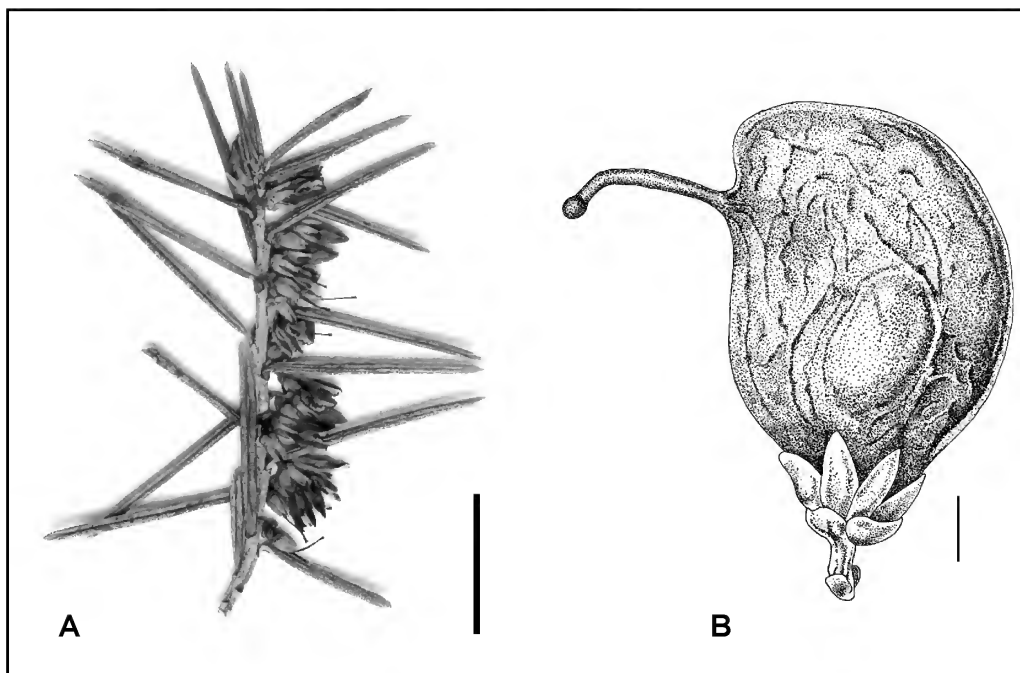


Figure 5. *Styphelia filifolia*. A – photograph of flowering branchlet from *F. Hort* 1746; B – fruit. Scale bars = 1 cm (A), 1 mm (B). Drawn by Skye Coffey from *F. Hort* 1410 (B).

10 June 2001, *M. Hislop* 2227 (CANB, PERTH); 21 Apr. 2002, *M. Hislop* 2561 (PERTH); 15 Oct. 2003, *M. Hislop* 3065 (PERTH); 28 Apr. 2002, *M. Hislop* & *A.W. Elliott* MH 2562 (PERTH); 4 Sep. 2001, *F. Hort* 1410 (PERTH); 21 Mar. 2002, *F. Hort* 1717 (NSW, PERTH); 22 Apr. 2002, *F. Hort* 1747 (CANB, PERTH); 23 Feb. 2006, *F. & B. Hort* 2790 (MEL, PERTH); 21 Oct. 1993, *B.J. Keighery* & *N. Gibson* 556 (PERTH); 7 July 2010, *C. Puente-Lelièvre*, *M. Hislop* & *E.A. Brown* CPL 60 (NSW, PERTH); 14 Mar. 2008, *V. Westcott* S.D. 11 a (PERTH); 2 Sep. 2006, *Wildflower Soc. of WA/DEC* IOPP 04/19 (PERTH).

**Distribution and habitat.** Occurs sporadically from north of Eneabba to the Harvey area (Figure 6) in the Geraldton Sandplains and Swan Coastal Plain bioregions. It grows on sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in *Banksia* or Jarrah woodland and in low-lying situations.

**Phenology.** The main flowering period is between March and May. Collections with mature fruit have been made between July and October.

**Etymology.** From the Latin *fili-* (thread-) and *-folius* (-leaved), a reference to the long, narrow leaf profile that is characteristic of the species.

**Conservation status.** Recently listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian flora under the name *Leucopogon* sp. Murdoch (*M. Hislop* 1037) (Western Australian Herbarium 1998–). Despite having a known distribution extending almost 400 km from north to south, this species appears to be nowhere common and its conservation status is problematic. The centre of its distribution is the fast-expanding Perth metropolitan area, with very

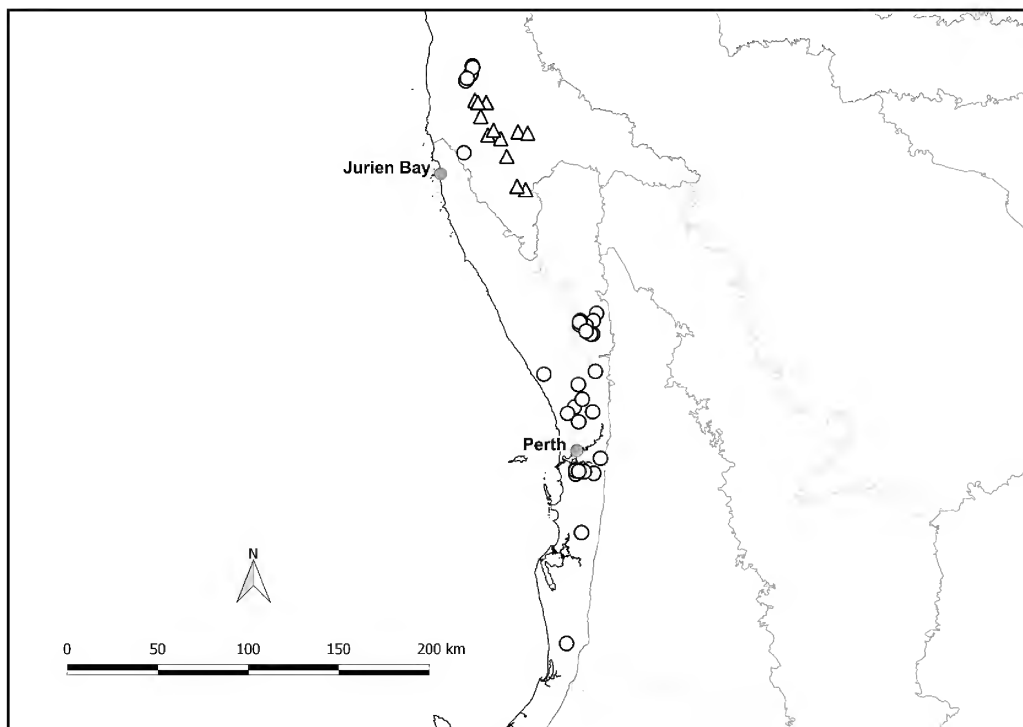


Figure 6. Distribution of *Styphelia filifolia* (O) and *S. williamsiorum* (Δ) in Western Australia.

few collections from the northern and southern parts of the species' range. However, it is certainly not a common plant around Perth either and was not even included in the treatment of *Leucopogon* in *Flora of the Perth Region* (Wheeler 1987). The most likely explanation for this absence is that so few collections were then available to the author (only two from within the Perth region prior to 1980), that it could have been reasonably regarded as an aberrant variant of *L. racemosus* DC. In addition, to judge by those collections where population size has been noted, and from the first author's field observations of the species, most populations are very small, consisting of few, scattered plants.

**Affinities.** *Styphelia filifolia*, together with *Leucopogon allittii* F.Muell. and *L. racemosus*, form a subgroup of the *L. pendulus* R.Br. group or Group V (*sensu* Puente-Lelièvre *et al.* 2016). The subgroup is characterised by a highly distinctive, zygomorphic fruit (Figure 5B) and a glabrous inflorescence axis. Two members of the subgroup (*L. racemosus* and *S. filifolia*, as *L. sp.* Murdoch) were sampled by Puente-Lelièvre *et al.* (2016) and found to occupy a basal position within Group V as strongly supported sister to the remainder of that large group.

Differences between the three members of the *L. racemosus* subgroup are given in Table 1 below. Most of the other *Styphelia* species with pendulous inflorescences occurring in the Geraldton Sandplains bioregion are members of the *L. conostephioides* group (*sensu* Puente-Lelièvre *et al.* 2016). *Styphelia filifolia* can be readily distinguished from all of those by its long, linear or very narrowly ovate leaves with strongly recurved to revolute margins and a mucronate but innocuous apex (*cf.* leaves ovate to narrowly ovate, usually concave, sometimes convex, but then without recurved margins, and long, sharply pungent mucros). In addition, *S. filifolia* has a dark green to black, glabrous ovary (as observed

on dried material), as opposed to the pale to mid-green, hairy ovaries common to the northern members of the *L. conostephiodes* group.

Two other members of the *L. pendulus* group with pendulous inflorescences occur in the Geraldton Sandplains, *L. strongylophyllus* F.Muell. and *L. sp.* Northern Scarp (M. Hislop 2233). The former is easily distinguished by its long-petiolate, broadly elliptic to obovate leaves, and the latter by its sharply pungent leaf mucros, narrowly obovate leaves and corolla tubes longer than the sepals.

All three members of the *L. racemulosus* subgroup have distributions in the Swan Coastal Plain bioregion. *Leucopogon racemulosus* and *S. filifolia* occur on the coastal plain in the general vicinity of Perth but generally occupy different landforms. The former usually grows on the Spearwood sands, often with limestone at depth, while *S. filifolia* occurs to the east on the deep Bassendean sands. Although the two are not known to be sympatric, they have been recorded growing as close as 2 km from each other in the Perth suburb of Murdoch. No intergrades or potential hybrids between the two are known. This is to be expected because the different size and orientation of the flowers is presumably indicative of a different pollinator.

While *L. allittii* does not occur on the coastal plain it is present on the northern Darling Scarp in the north-east of the Swan Coastal Plain bioregion. At one locality in this area, Boonanarring Nature Reserve, both *L. allittii* and *S. filifolia* occur, although it is not known whether the two are sympatric in the same habitat. This is the only recorded occurrence of *S. filifolia* to the east of the coastal plain.

**Table 1.** Comparison of morphological characters and distributions of the three members of the *Leucopogon racemulosus* subgroup.

Character	<i>L. racemulosus</i>	<i>L. allittii</i>	<i>Styphelia filifolia</i>
Mucro of mature leaves	sharply pungent, 0.5–1.5 mm long	sharply pungent, 0.5–1.0 mm long	blunt, 0.2–0.5 mm long
Leaf shape	mostly linear, less often very narrowly ovate or very narrowly elliptic	narrowly ovate to narrowly triangular	mostly linear, occasionally very narrowly ovate
Length (including petiole) to width ratio of longest leaves	6.7–27:1	2.1–5:1	8.4–22.7(–35.7):1
Inflorescence orientation	widely spreading (c. 45–100° relative to branchlet axis)	widely spreading (c. 45–100° relative to branchlet axis)	strictly pendulous
Corolla tube	much longer than the sepals	much longer than the sepals	± the same length as sepals (from slightly shorter than, to slightly longer than)
Distribution	somewhat disjunct: W coastal plain from Lancelin to Yalgorup, then in coastal heath and forest from Margaret River to Two Peoples Bay	very disjunct: a N population node in the Ajana–Yuna area, a S node between Mogumber and Bindoon	sporadic on coastal plain between Eneabba and Harvey

**Styphelia longissima** Hislop & Puente-Lel., *sp. nov.*

*Typus*: north of Eneabba, Western Australia [precise locality withheld for conservation reasons], 19 July 2004, M. Hislop 3286 (*holo*: PERTH 07098170; *iso*: NSW).

*Leucopogon* sp. ciliate Eneabba (F. Obbens & C. Godden s.n. 3/7/2003), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 12 February 2016]

Erect *shrubs*, to *c.* 70 cm high and 70 cm wide, from a fire-sensitive rootstock. Young *branchlets* with a moderately dense to dense indumentum of variously orientated hairs to *c.* 0.5 mm long. *Leaves* helically arranged, steeply antrorse to antrorse-appressed and stem-clasping, narrowly ovate to narrowly elliptic, 7–13 mm long, 2.0–3.8 mm wide; petiole well-defined, 0.8–1.5 mm long, hairy throughout or the abaxial surface glabrous; base cuneate; apex long-mucronate, pungent, the mucro 1.4–3.0 mm long, fine and rather brittle; lamina strongly concave adaxially to  $\pm$  involute, the longitudinal axis gently incurved to  $\pm$  straight; surfaces  $\pm$  concolorous, shiny; adaxial surface glabrous, except sometimes for a few hairs towards the base, the venation not evident; abaxial surface glabrous, striate with 5–7 raised primary veins; margins usually densely long-ciliate with hairs 0.5–1.0 mm long, but sometimes with fewer, much shorter hairs or  $\pm$  glabrous. *Inflorescence* axillary, erect; axis 1.8–2.3 mm long, 1-flowered, flat and bract-like above the fertile node and terminating in a bud rudiment; axis indumentum moderately dense with hairs 0.1–0.2 mm long; flowers erect, sessile. *Fertile bracts* ovate to elliptic, 1.8–2.5 mm long, 1.0–1.4 mm wide, subtended by 3 or 4 smaller, sterile bracts. *Bracteoles* ovate to elliptic, 2.4–3.2 mm long, 1.5–2.0 mm wide, obtuse, mucronate; abaxial surface  $\pm$  glabrous to minutely scabrous, pale brown, striate; margins ciliate. *Sepals* narrowly ovate to narrowly elliptic, 5.0–6.8 mm long, 1.4–1.8 mm wide, acuminate, long-mucronate; abaxial surface  $\pm$  glabrous to minutely scabrous, straw-coloured, striate; margins ciliolate with longer hairs (to 0.2 mm long) towards the base. *Corolla tube* white, narrowly ellipsoid to narrowly obovoid, about as long as, or a little shorter than, the sepals, 4.4–4.8 mm long, 2.5–3.0 mm wide, glabrous externally, hairy internally towards the apex. *Corolla lobes* white, shorter than the tube, erect in basal 1/3–1/2 and then spreading and recurved, 3.2–4.0 mm long, 1.0–1.5 mm wide at base; external surface glabrous, apart sometimes for a few hairs about the apex; internal surface with a dense indumentum of  $\pm$  terete, twisted, strongly ornamented hairs. *Anthers* partially exserted from the tube (by 1/2–2/3 of their length), 2.4–3.0 mm long, apex emarginate. *Filaments* terete, 0.5–0.7 mm long, adnate to tube just below the sinuses, attached to anther *c.* 2/3 above base. *Ovary* mid-green, ovoid, 0.8–0.9 mm long, 0.5–0.6 mm wide, with a dense indumentum of hairs, 0.5–0.8 mm long, 2(3)-locular. *Style* scabrous in the upper half, 5.5–6.8 mm long, tapering smoothly from ovary apex, exserted from corolla tube, held at *c.* the level of the erect bases of the corolla lobes; stigma distinctly expanded. *Nectary* annular, shallowly lobed, 0.6–1.0 mm long, glabrous. *Fruit* not seen. (Figure 7)

*Diagnostic characters.* This species can be distinguished from all others by the very long leaf mucros, usually long-ciliate leaf margins and densely, long-hairy, 2(3)-locular ovaries.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 14 July 2003, C. Godden Ep 4 (CANB, NSW, PERTH); 14 July 2003, C. Godden Ep E (CANB, MEL, PERTH); 13 June 2007, F. Obbens & D. Coultas Opp 1 (PERTH); 3 July 2003, F. Obbens & C. Godden s.n. (PERTH).

*Distribution and habitat.* Known only from a small area near Eneabba in the Geraldton Sandplains bioregion. It grows on yellow sand at the eastern edge of the coastal plain in heath and open low

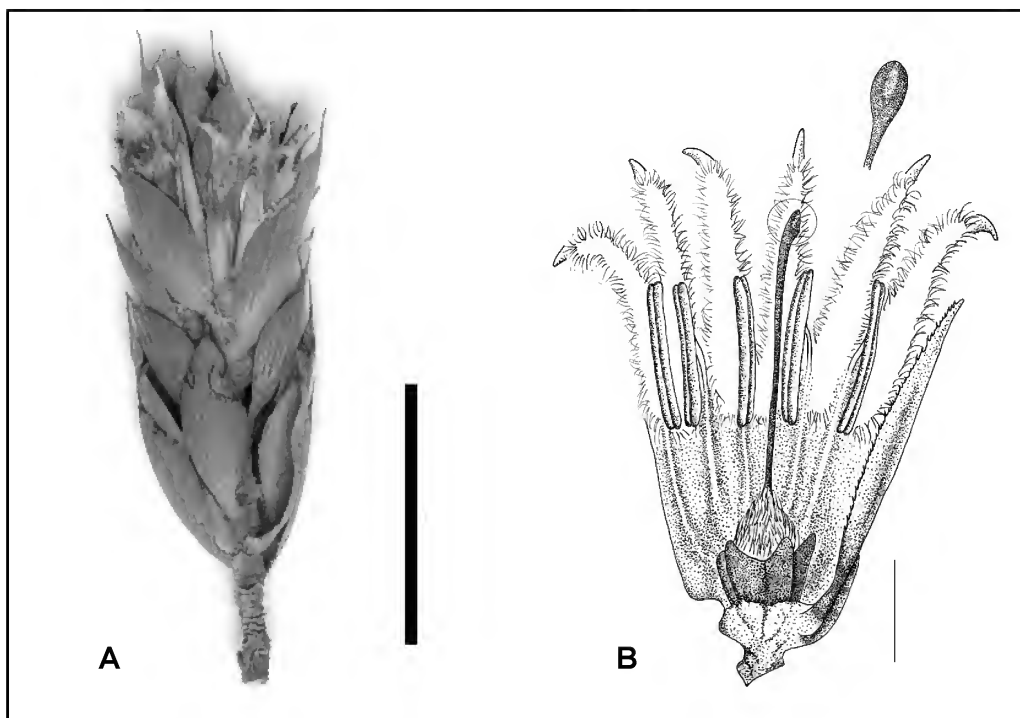


Figure 7. *Styphelia longissima*. A – photograph of flowering branchlet from F. Obbens & D. Coultas Opp1. B – flower, slit open longitudinally. Scale bars = 1 cm (A) 1 mm (B). Drawn by Skye Coffey from F. Obbens & D. Coultas Opp1.

woodland. The more common associated species include *Banksia attenuata*, *B. hookeriana*, *Xylomelum angustifolium*, *Hibbertia hypericoides*, *Chordifex sinuosus*, *Jacksonia floribunda*, *Calothamnus glaber*, *Darwinia pauciflora* and *Astroloma xerophyllum*.

**Phenology.** Peak flowering is likely to be between May and July. The fruit has not been seen but could be expected to be present from about September.

**Etymology.** From the Latin *longissimus* (very long), a reference to the long leaf mucros, marginal cilia and ovarian hairs of this species.

**Conservation status.** Department of Parks and Wildlife Conservation Codes for Western Australian Flora: Threatened Flora, currently ranked as Vulnerable (Jones 2015). Despite a concerted and systematic search-effort this species is still only known from a single population.

**Affinities.** A member of the *Astroloma xerophyllum* (DC.) Sond. group or Group IX (*sensu* Puente-Lelièvre *et al.* 2016). This group comprises another two described species (*A. xerophyllum* and *A. stomarrhena* Sond.) and four phrase-named taxa. Of the three other group members that occur in the Geraldton Sandplains, *S. longissima* could only reasonably be confused with *A. xerophyllum*, a species with which it grows sympatrically. However, the differences between the two are many. Relative to *A. xerophyllum*, *S. longissima* has longer leaf mucros, 1.4–3.0 mm long (*cf.* up to 1.5 mm, but usually *c.* 1 mm long in *A. xerophyllum*), long leaf cilia (*cf.* margins glabrous or minutely ciliolate), acuminate sepal apices (*cf.* obtuse) and a hairy 2(3)-locular ovary (*cf.* glabrous, 5-locular).

The topology of Group IX obtained by Puente-Lelièvre *et al.* (2016) shows a sister relationship between *S. longissima* (as *L. sp.* ciliate Eneabba) and the species-pair, *Astroloma sp.* sessile leaf (J.L. Robson 657) and *Leucopogon sp.* Ongerup (A.S. George 16682). The latter occur respectively in the Jarrah Forest and Mallee Bioregions, well to the south of the Eneabba area. The most obvious differences between *S. longissima* and these two species are the densely hairy ovary of *S. longissima* (*cf.* glabrous in *L. sp.* Ongerup and *A. sp.* sessile leaf) and long leaf cilia (*cf.* glabrous or minutely ciliate).

Within the Geraldton Sandplains bioregion the only other species that could conceivably be confused with *S. longissima* is *Croninia kingiana* (F.Muell.) J.M.Powell. The two share the unusual feature of having long, dense hairs that totally obscure the surface of the ovary. There are however many differences between them including leaf morphology (leaves striate with shallow grooves between the primary veins and obvious secondary venation in *S. longissima*, *cf.* leaves deeply grooved with no secondary development in *Croninia*), style tapering smoothly from ovary apex in *S. longissima* (*cf.* style arising from an apical depression and soon detached) and a 2- rather than 5-locular ovary. The characteristically long leaf mucros and leaf cilia of *S. longissima* are further points of differences between the two species.

***Styphelia williamsiorum*** Hislop & Puente-Lel., *sp. nov.*

*Typus*: Badgingarra National Park, 7 km west of Brand Highway along Cadda Road, Western Australia, 13 November 2004, *M. Hislop* 3346 (*holo*: PERTH 07202911; *iso*: CANB, NSW).

*Leucopogon sp.* Warradarge (M. Hislop 1908), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 12 February 2016]

Low, compact *shrubs*, to c. 30 cm high and 40 cm wide, from a fire-sensitive rootstock. Young *branchlets* with a moderately dense indumentum of shallowly antrorse to shallowly retrorse, straight or curved hairs to 0.3 mm long. *Leaves* opposite, strongly decussate, steeply antrorse to antrorse-appressed, narrowly ovate, 3.0–7.0 mm long, 0.5–1.8 mm wide; petiole rather obscure to c. 0.4 mm long, glabrous or hairy; base attenuate to cuneate; apex mucronate, rather weakly pungent, the mucro 0.2–0.4 mm long, straight to  $\pm$  uncinat; lamina usually adaxially concave, sometimes  $\pm$  flat, the longitudinal axis incurved; surfaces  $\pm$  concolorous; adaxial surface  $\pm$  matt, usually with a sparse to moderately dense indumentum of antrorse hairs, sometimes  $\pm$  glabrous, venation not evident; abaxial surface shiny, variously hairy or  $\pm$  glabrous, with 5–7 primary veins, flat to broadly and shallowly grooved between the veins; margins glabrous or sparsely and irregularly ciliate with hairs to c. 0.6 mm long. *Inflorescences* axillary, erect, clustered towards the branchlet apices; axis 0.5–0.6 mm long, 1-flowered, slightly compressed, apparently terminating in a flower, bud-rudiment absent; axis indumentum moderately dense, c. 0.1 mm long; flowers erect, sessile. *Fertile bracts* elliptic to ovate, 0.3–0.5(–0.8) mm long, 0.2–0.3 mm wide, with a larger bract opposite (i.e. on the adaxial axis surface) and another pair of sterile bracts inserted immediately below (and on the same plane as) the bracteoles. *Bracteoles* ovate, 1.0–1.4 mm long, 0.7–0.8 mm wide, acute to obtuse; abaxial surface glabrous or sparsely hairy; margins ciliate. *Sepals* narrowly ovate, 1.7–2.4 mm long, 0.7–1.0 mm wide, acute to obtuse with a  $\pm$  recurved or less frequently appressed apex; abaxial surface glabrous or occasionally sparsely hairy, pale green, venation very obscure; margins irregularly ciliate with hairs 0.05–0.20 mm long. *Corolla tube* deep purple, cylindrical in the upper portion, usually becoming slightly expanded in the lower 1/3, much longer than the sepals, 3.3–5.8(–7.0) mm long, 0.8–1.6 mm wide; the external surface of the cylindrical portion moderately to sparsely hairy, or very occasionally glabrous (see comment under *Notes* below), the expanded basal portion glabrous; the internal surface of the cylindrical portion with an apical ring of hairs of variable length and density, projecting into the tube, then sparsely hairy below,

the expanded basal portion glabrous. *Corolla lobes* deep purple, much shorter than the tube, spreading from the base and recurved, 1.3–2.2 mm long, 0.5–0.7 mm wide at base; external surface glabrous, or sparsely hairy; internal surface with a dense indumentum of terete, straight and unornamented hairs, becoming glabrous towards the base. *Anthers* fully included within the tube, 0.7–1.5 mm long, apex shallowly emarginate. *Filaments* terete, 0.1–0.2 mm long, attached 2/3–3/4 above anther base, adnate at a point 2/3–3/4 the length of the tube above the base. *Ovary* pale green, narrowly ovoid, 1.3–2.0 mm long (measurement includes the vestigial style), 0.35–0.50 mm wide, with a dense tuft of antrorse hairs (to c. 0.3 mm long) at the base, glabrous in the upper half, 3-locular. *Style* very short and ill-defined on flowering material (but becoming well-defined in fruit), tapering smoothly from ovary apex, included within corolla tube; stigma expanded. *Nectary* partite, the scales 0.3–0.5 mm long, 0.2–0.3 mm wide, glabrous. *Fruit* longer than the sepals, narrowly ellipsoid, c. 2.0–2.2 mm long, 0.5–0.6 mm wide, circular in section; surface dry, smooth (mesocarp poorly developed), with prominent pale, slightly raised, longitudinal ribs, hairy with a sparse, antrorse indumentum throughout; apex acute, tapering smoothly to the persistent, thickened style, c. 0.5 mm long (refer to comment under *Notes* below). (Figures 8, 9)

*Diagnostic characters.* Distinguished from all other members of the genus by the following combination of characters: gynoecium conical in the upper 1/2 with a very short style and 3 very narrow and obscure locules; nectary partite; leaves opposite and decussate, flat or shallowly and broadly grooved between the veins on their abaxial surfaces; external corolla tube dark purple and hairy; anthers presented well below the corolla tube apex.

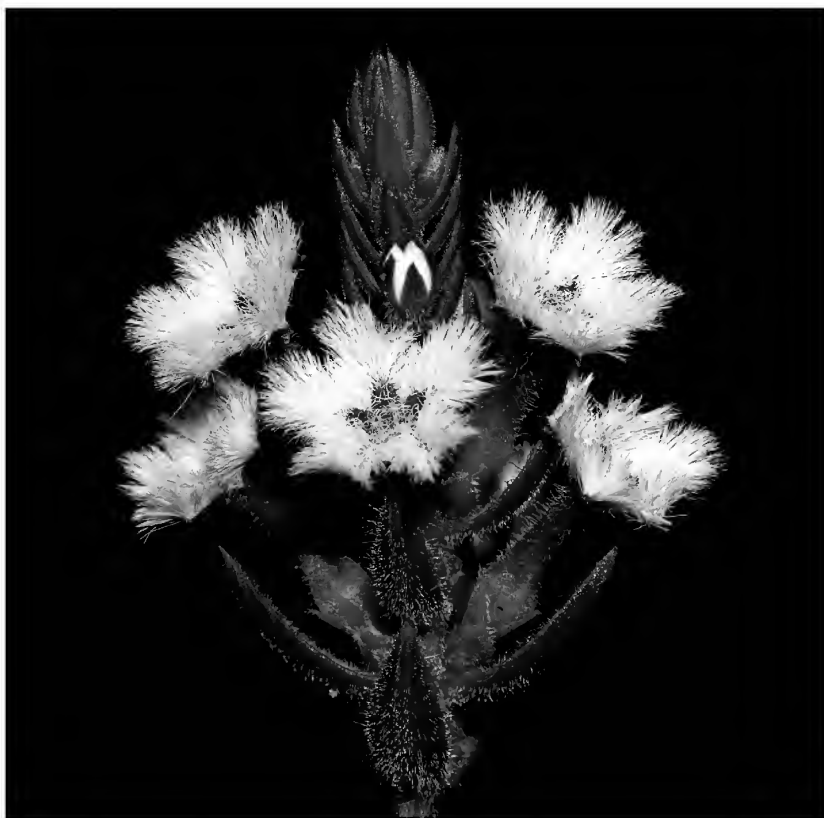


Figure 8. *Styphelia williamsiorum*. Leaves and inflorescence (R. Davis & A. Perkins RD 12490). Photograph by R. Davis.

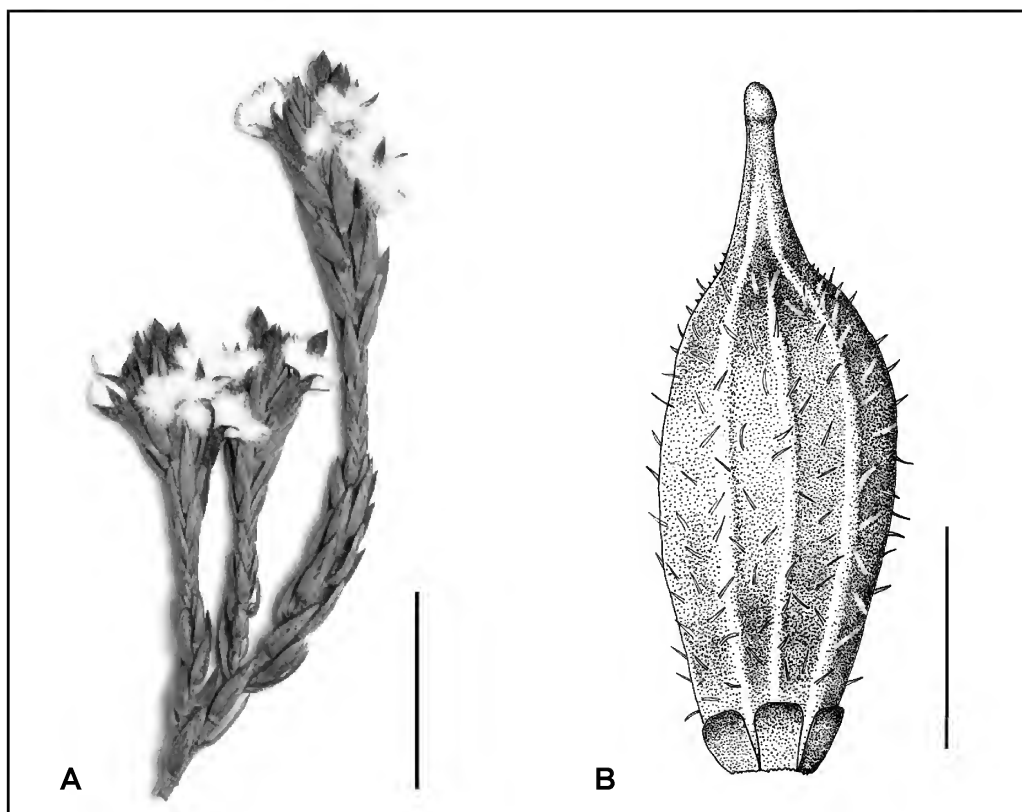


Figure 9. *Styphelia williamsiorum*. A – photograph of flowering branchlet from *M. Hislop* 3346; B – fruit. Scale bar = 1 cm (A), 1 mm (B). Drawn by Skye Coffey from *M. Hislop* 3346 (B).

*Other specimens examined.* WESTERNAUSTRALIA: Lesueur National Park, Gardner track via Brumby track, 9.5 km E of Cockleshell Gully Rd, 27 Nov. 2002, *A. Crawford & K. Biggs s.n.* (PERTH); private property, NE of Halfway Mill Roadhouse [Warradarge], 19 Oct. 2014, *R. Davis & A. Perkins* RD 12490 (PERTH); N of Badgingarra, 29 Oct. 1966, *A.S. George* 8629 (CANB, NSW, PERTH); Reserve 31030 [South Eneabba Nature Reserve], 14 Nov. 1981, *E.A. Griffin* 3254 (PERTH); [Badgingarra National Park], N boundary of Park, Bibby Rd, W of Badgingarra, 7 Dec. 1992, *E.A. Griffin* 8324 (PERTH); in block of remnant vegetation on private farmland ('Breakaway', J. & J. Brown), off Green Head–Coorow Rd, c. 3 km W of Brand Hwy, 14 Dec. 1996, *M. Hislop* 638 (PERTH); Hi Vallee property (D. & J. Williams) Warradarge, base of W breakaways of main valley, 6 Dec. 2002, *M. Hislop* 2902 (MEL, NSW, PERTH); Alexander Morrison National Park, Toothardie Rd at southern boundary of S block, 13 Nov. 2004, *M. Hislop* 3350 (CANB, PERTH); Hi Vallee property. Along W track in the main valley, 7 July 2010, *C. Puente-Lelièvre, M. Hislop & E.A. Brown* CPL 59 (NSW, PERTH).

*Distribution and habitat.* Restricted to the Geraldton Sandplains bioregion, from south of Eneabba to the Badgingarra area and as far east as Alexander Morrison National Park (Figure 6). It grows on lateritic uplands, often close to breakaways, in shallow, sandy soils, and in association with low, species-rich heath.

*Phenology.* Flowering is mostly between mid-October and mid-December. The only specimen with mature fruit present was collected in July.

*Etymology.* The epithet honours Don and Joy Williams of Hi Vallee farm, north-east of Badgingarra, where the species is locally common. Don and Joy are both farmers and naturalists with a deep knowledge of their local flora and fauna. Through their farm-stays and guided tours of Hi Vallee and surrounding areas, they have opened the eyes of countless visitors to the rich biodiversity of the Geraldton Sandplains.

*Conservation status.* *Styphelia williamsiorum* has a sporadic distribution across its rather restricted geographical range. It is however locally common and well represented on the conservation estate, where it is known to occur in three national parks and one nature reserve. No conservation coding.

*Affinities.* This species belongs to a well-supported subclade of the highly diverse Group X (*sensu* Puente-Lelièvre *et al.* 2016). The subclade is characterised by a distinctive gynoeceum which is conical in the upper half, with a very short or vestigial style and with three extremely narrow and obscure ovarian locules. *Styphelia williamsiorum* (as *L. sp.* Warradarge) was one of seven taxa from the subclade included in the recently published molecular phylogenetic analysis (Puente-Lelièvre *et al.* 2016). In total there are currently considered to be 17 Western Australian taxa in the subclade, but *S. williamsiorum* is just the fifth to be formally described.

Six members of the subclade, including *S. williamsiorum*, have opposite leaves, a character that occurs nowhere else in the genus. Elsewhere in the tribe Styphelieae opposite leaves are found only in *Leucopogon s. str.*, where the character has a restricted occurrence among species from Groups D and E (*sensu* Hislop & Chapman 2007).

In the Geraldton Sandplains *S. williamsiorum* is only likely to be confused with the phrase-named taxa *L. sp.* Yandanooka (M. Hislop 2507) and *L. sp.* Tathra (M. Hislop 2900), which also have opposite leaves and, at least in the case of the former, strongly pigmented corollas. *Leucopogon sp.* Yandanooka may be distinguished by its glabrous external corolla tube and ovary, eciliate sepal margins, and anthers which are presented at the throat of the corolla tube (i.e. the tips are more or less level with the apex of the tube). *Styphelia williamsiorum*, by contrast, has a hairy corolla tube (but refer to exception discussed in notes below) and ovary, ciliate sepal margins, and anthers which are held well below the throat of the corolla tube. There is also a difference in the filament-to-anther attachment point, which in *L. sp.* Yandanooka is at or very close to the anther apex, whereas in *S. williamsiorum* it is at a point 2/3–3/4 above the anther base. The two species are apparently allopatric with *L. sp.* Yandanooka occurring in generally similar habitats to the north of the known distribution of *S. williamsiorum*.

The phylogenetic tree topology obtained by Puente-Lelièvre *et al.* (2016) indicates that the closest relative of *S. williamsiorum* is *L. sp.* Tathra. The latter can be distinguished from *S. williamsiorum* by the following character differences: adaxial leaf surfaces strongly grooved between the veins (*cf.* flat to shallowly and broadly grooved between the veins in *S. williamsiorum*); abaxial sepal surfaces hairy (*cf.* glabrous or occasionally sparsely hairy); corolla greenish or yellow-cream sometimes partially flushed with red or purple (*cf.* deep purple throughout). There is also a difference in the position of the filament to anther connection: 2/3–3/4 above anther base in *S. williamsiorum* and 1/2–2/3 in *L. sp.* Tathra. In a couple of specimens, however, there is some breakdown in these distinguishing features. The two are allopatric with the latter occurring to the east of *S. williamsiorum*.

Of the previously described taxa in the subclade the only one with opposite leaves is *L. tamminensis* E.Pritz. var. *australis* E.Pritz. That taxon occurs far to the south of *S. williamsiorum* in the Mallee, Esperance Plains and southern Avon Wheatbelt bioregions and for that reason alone they are unlikely

to be confused. The two can, in any case, be easily distinguished by the following characters: sepals always with dark, acute apices and variously hairy adaxially in *L. tamminensis* var. *australis* (cf. sepal apices obtuse to acute, lacking dark pigment, glabrous adaxially in *S. williamsiorum*); filaments fixed at anther apex (cf. filaments fixed 2/3–3/4 above anther base); short ovarian hairs scattered across the lower 1/2–3/4 (cf. ovarian hairs longer, restricted to basal tuft). The corolla tubes of *L. tamminensis* var. *australis* are also shorter (i.e. up to c. 3 mm long compared to 3.3–5.8 mm in *S. williamsiorum*), and although often flushed pink they lack the uniform dark purple coloration of the new species. It is worth noting here that var. *australis* differs from the typical variety of *L. tamminensis* in numerous ways, including phyllotaxis, and will be recognised as a distinct species in due course.

**Notes.** The most westerly collection of the species (*A. Crawford & K. Biggs s.n.*), is atypical in respect to a significant corolla character. Rather than the usual hairy external corolla tube, in this specimen it is totally glabrous, although in all other respects its morphology conforms with this species.

The description of the fruit given in the text above is based on a single specimen bearing mature fruits and therefore cannot be regarded as definitive.

### Acknowledgements

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## SHORT COMMUNICATION

***Hibbertia sejuncta*, a new, rare species from Western Australia, with notes on *H. helianthemoides***

*Hibbertia helianthemoides* (Turcz.) F.Muell. was described (as *Candollea helianthemoides* Turcz.) in 1849, based on a specimen collected by James Drummond on his 4<sup>th</sup> collecting expedition, most likely in the Stirling Range (Drummond's 4<sup>th</sup> expedition traversed the Stirling Range (George 2009), and the type specimen closely matches specimens from there). Wheeler (2002), in a revision of a small species group that she regarded included *H. helianthemoides*, accepted it as endemic in the Stirling Range, with the exception of one specimen from near Tenterden, which is outside the Range but close to its western end. Wheeler subsequently determined a number of specimens at PERTH, particularly from the area between Perth and Eneabba, as a 'northern variant' of *H. helianthemoides*, although this variant was not provided with a formal phrase name.

A conservation assessment of *H. helianthemoides* s. str. (i.e. before the inclusion of the 'northern variant') led to it being listed as Priority Four under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015). However, under the expanded circumscription including the 'northern variant', a conservation rating of 'Least Concern' would be warranted. Given uncertainty regarding the taxonomic status of the 'northern variant', a review of the species was initiated to help determine its range and conservation status.

After study of all available material of *H. helianthemoides* at the Western Australian Herbarium, it became clear that: (1) only specimens from the western end of the Stirling Range match the type; (2) all specimens of the 'northern variant' can be adequately referred to a number of other taxa including *H. sericosepala* K.R.Thiele, *H. huegelii* (Endl.) F.Muell., *H. leucocrossa* K.R.Thiele and *H. desmophylla* (Benth.) F.Muell.; (3) five specimens from two widely disjunct localities in the Avon Wheatbelt bioregion (Department of the Environment 2013), from near Tenterden and Lake Muir, comprise a new species described here as *H. sejuncta* K.R.Thiele & Nge.

***Hibbertia sejuncta* K.R.Thiele & Nge, *sp. nov.***

*Type*: [near Tenterden] Western Australia [precise locality withheld for conservation reasons], 22 August 2016, K.R. Thiele 5353 (*holo*: PERTH 08813477; *iso*: AD, CANB).

*Hibbertia* sp. Tenterden (M. Sowry 154), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 18 August 2016].

Low-growing *shrubs* to 25 cm high, with short, erect branches from prostrate or spreading main stems, resprouting from the rootstock after fire; branchlets moderately crisped-pubescent with white to pale grey, simple, spreading hairs. *Leaves* crowded, ± fasciculate, linear, (3.5–)8–10(–20) mm long, 0.6–0.8 mm wide; leaf lamina very narrow but distinctly recurved (abaxial surface grooved adjacent to the relatively broad midrib), non-tuberculate, sparsely pilose with spreading, crisped, white to pale grey, simple hairs to c. 1 mm long; apex obtuse. *Flowers* sessile, mostly single and terminating

axillary short-shoots; flower-subtending bracts 3–5, brown, scarious, to 1.5 mm long, the upper ones orbicular and glabrous, the lower ones narrower, acute, and with a sparse indumentum as for the leaves. *Sepals* 5, ovate, 3.5–5.2 mm long, glabrous, thin-textured except for a slightly thicker but not prominent midrib; outer sepals shorter and more acute than the inner, which are obtuse-apiculate. *Petals* 5, yellow, broadly obovate, 4.0–5.5 mm long,  $\pm$  entire to deeply emarginate. *Stamens* 11, all around the gynoecium, in 3 bundles of 3 stamens each fused by their filaments, and with two single stamens; filaments 1.0–1.2 mm long, those of the stamen bundles fused for most of their length except the inner stamen which has a slightly longer free portion; anthers rectangular, 1.2–1.5 mm long, dehiscing by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 3; ovaries compressed-globular, glabrous; styles excentrically erect-incurved from the carpel apex, 1.2–1.8 mm long. *Ovules* 1(2) per carpel. *Seeds*  $\pm$  globular, glossy, brown, c. 2 mm diam.; aril pale, deeply divided into finger-like lobes, covering < half the seed.

*Diagnostic features.* *Hibbertia sejuncta* may be distinguished from all other Western Australian taxa by its combination of stamens arranged all around the three glabrous carpels, with two free stamens and three bundles of three stamens each, and linear, pilose leaves with the lamina very narrow but distinctly recurved either side of a prominent midrib.

*Specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 20 July 1993, A.R. Annel's 3432 (PERTH); 24 Oct. 2003, E.M. Sandiford 917 (PERTH); 4 Nov. 2003, E.M. Sandiford 921 (PERTH); 14 Nov. 2003, E.M. Sandiford 939 (PERTH); 8 Sep. 2009, M. Sowry 154 (PERTH).

*Phenology.* Peak flowering is in late winter and early spring, with sporadic flowering at other times of year when conditions are suitable.

*Distribution and habitat.* *Hibbertia sejuncta* occurs at two widely disjunct locations, near Tenterden and near Lake Muir. At both sites it occurs in winter-damp areas on gentle slopes adjacent to minor drainage lines and run-on areas, in grey sand beneath low, open jarrah forest.

*Conservation status.* *Hibbertia sejuncta* is listed by Jones (2015) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *H. sp.* Tenterden (M. Sowry 154).

*Etymology.* The epithet is from the Latin *sejunctus* (disjointed, separated) and refers to the highly disjunct distribution of the new species. While further collections may uncover new populations, the area in which it occurs is well-collected for *Hibbertia*, and the taxon is likely to remain disjunct and scattered.

*Notes.* *Hibbertia sejuncta* belongs in *Hibbertia* Andrews subgen. *Hibbertia*, and may be phylogenetically close to *H. helianthemoides*. Although neither species was included in the only available phylogenetic analysis of the genus (Horn 2005), they are morphologically closely related to species in a well-supported clade comprising *H. depressa* Steud., *H. fitzgeraldensis* J.R. Wheeler, *H. hibbertioides* (Steud.) J.R. Wheeler, *H. notibractea* J.R. Wheeler, *H. rupicola* (S. Moore) C.A. Gardner and *H. sericosepala* (as *H. sp.* Gngangara). These taxa share an actinomorphic androecium with stamens in five bundles united by their filaments (in some species with two stamens single) surrounding three (rarely five) glabrous, uniovulate carpels.

*Hibbertia sejuncta* has the narrowest leaves of any species in subgen. *Hibbertia*, with the recurved lamina scarcely wider than the prominent midrib. In this respect it is similar to many species of subgen. *Hemistemma* Juss. ex Thouars that have short, ‘ericoid’ leaves with a strongly revolute lamina appressed to the midrib abaxially. Horn (2005) noted that all species in subgen. *Hemistemma* have leaves with a single vascular trace at base, while leaves in subgen. *Hibbertia* are 3-traced. *Hibbertia sejuncta* leaves are 1-traced like those of subgen. *Hemistemma*, indicating that this character may be partially a reflection of leaf width rather than being phylogenetically informative.

A specimen from near Wickepin initially assigned to *H.* sp. Tenterden (*H.B. Shugg s.n.* PERTH 04388348), is superficially similar to *H. sejuncta* but lacks its distinctive leaves, instead having narrow but flat leaves without a revolute lamina; it also has a more appressed leaf indumentum. It has been tentatively assigned as a significant range extension of *H. priceana* J.R.Wheeler, to which it is most similar.

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## SHORT COMMUNICATION

## Updates to Western Australia's vascular plant census for 2016

The census database at the Western Australian Herbarium (PERTH), which provides the nomenclature for the website *FloraBase* (Western Australian Herbarium 1998–), lists current names and recent synonymy for Western Australia's native and naturalised vascular plants, as well as algae, bryophytes, lichens, slime moulds and some fungi. The names represented in the census are either sourced from published research or denote as yet unpublished names based on herbarium voucher specimens. We herein summarise the changes made to vascular plant names in this database during 2016.

Eighty-six taxa were newly recorded for the State, of which 29 are naturalised and 25 have been added to the *Threatened and Priority Flora list for Western Australia* (Western Australian Herbarium 1998–) (Table 1). A total of 150 name changes were made (Table 2). Plant groups for which a number of name changes were made include *Malleostemon* J.W.Green, with the formal publication of numerous phrase names (Rye 2016), and *Logania* R.Br., with the transfer of many Western Australian species to the new genus *Orianthera* C.S.P.Foster & B.J.Conn (Foster *et al.* 2014). All taxa previously included under the genus *Keraudrenia* J.Gay have been transferred to *Seringia* J.Gay (Wilkins & Whitlock 2016). A number of changes were made in Restionaceae following publications in *Telopea* (Briggs 2014a, 2014b) that resulted in the sinking of several genera endemic to Western Australia: *Meeboldina* Suess. and *Stenotalis* B.G.Briggs & L.A.S.Johnson are now included in an enlarged *Leptocarpus* R.Br., and *Harperia* W.Fitzg., *Kulinia* B.G.Briggs & L.A.S.Johnson and *Onychosepalum* Steud. are now synonymised under *Desmocladius* Nees.

A single manuscript name was changed to a phrase name under Council of Heads of Australasian Herbaria (CHAH) guidelines for informal names (Barker 2005), while 14 manuscript names and 19 phrase names were formally published (Table 2). Table 2 also includes cases where there has been a change of taxonomic concept, misapplication, exclusion or rank change.

**Table 1.** New records added to Western Australia's vascular plant census during 2016. *in litt.* = in correspondence; *in sched.* = on herbarium sheet/label; \* = naturalised; T, P1–P4 = Department of Parks and Wildlife Conservation Codes for Western Australian flora (Jones 2015; Western Australian Herbarium 1998–).

New Name	Status	Comments
<i>Agave attenuata</i> Salm-Dyck	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/08/2016).
<i>Allopterigeron filifolius</i> (F.Muell.) Dunlop		New record for WA. M. Hislop <i>in sched.</i> (05/07/2016).
<i>Ambrosia tenuifolia</i> Spreng.	*	New naturalised record for WA. See Orchard (2015c).
<i>Anisomeles brevopilosa</i> A.R.Bean		See Bean (2015).
<i>Anisomeles farinacea</i> A.R.Bean		See Bean (2015).

New Name	Status	Comments
<i>Anisomeles inodora</i> R.Br.		New record for WA. See Bean (2015).
<i>Anisomeles principis</i> A.R.Bean		See Bean (2015).
<i>Anisomeles viscidula</i> A.R.Bean		See Bean (2015).
<i>Arctotheca calendula</i> (L.) Levyns × <i>Arctotheca populifolia</i> (P.J.Bergius) Norl.	*	See Ghafoor (2015a).
<i>Austrostipa</i> sp. Koorda (Anonymous s.n. PERTH 08730202)	P1	A.R. Williams <i>in litt.</i> (01/02/2016).
<i>Baeckea</i> sp. Dandaragan (G. Paczkowska s.n. PERTH 08245606)	P1	B.L. Rye <i>in litt.</i> (23/10/2015).
<i>Banksia integrifolia</i> L.f.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (30/06/2015).
<i>Banksia integrifolia</i> L.f. subsp. <i>integrifolia</i>	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (30/06/2015).
<i>Beaufortia kwongkanicola</i> A.A.Burb.		See Burbidge (2016).
<i>Beaufortia raggedensis</i> A.A.Burb.	P2	See Burbidge (2016).
<i>Bidens pilosa</i> var. <i>minor</i> (Blume) Sherff	*	New naturalised record for WA. See Orchard (2015a).
<i>Bidens pilosa</i> L. var. <i>pilosa</i>	*	New naturalised record for WA. See Orchard (2015a).
<i>Bidens subalternans</i> DC.	*	New naturalised record for WA. See Orchard (2015a).
<i>Bidens subalternans</i> var. <i>araneosa</i> Orchard	*	See Orchard (2015a). Considered naturalised, fide G.J. Keighery <i>in litt.</i> (01/04/2016).
<i>Bidens subalternans</i> var. <i>simulans</i> Sherff	*	New naturalised record for WA. See Orchard (2015a).
<i>Bidens subalternans</i> DC. var. <i>subalternans</i>	*	New naturalised record for WA. See Orchard (2015a).
<i>Blumea benthamiana</i> Domin		New record for WA. See Dunlop & Orchard (2015).
<i>Carum carvi</i> L.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (14/09/2015).
<i>Chrysocephalum apiculatum</i> subsp. <i>glandulosum</i> Paul G.Wilson		See Wilson (2016).
<i>Chrysocephalum apiculatum</i> subsp. <i>norsemanense</i> Paul G.Wilson	P3	See Wilson (2016).
<i>Chrysocephalum apiculatum</i> subsp. <i>racemosum</i> (J.M.Black) Paul G.Wilson		See Wilson (2016).
<i>Chrysocephalum semipapposum</i> subsp. <i>occidentale</i> (Benth.) Paul G.Wilson		See Wilson (2016).
<i>Corymbia deserticola</i> subsp. <i>mesogeotica</i> K.D.Hill & L.A.S.Johnson		New record for WA. R. Butcher <i>in litt.</i> (27/04/2016).
<i>Cryptandra</i> sp. Cowcowing (Wittwer W 1210)	P3	B.L. Rye <i>in litt.</i> (06/11/2015).

New Name	Status	Comments
<i>Cyanthillium cinereum</i> (L.) H.Rob. var. <i>cinereum</i>	*	New naturalised record for WA. See Ghafoor (2015b).
<i>Cyanthillium cinereum</i> var. <i>lanatum</i> (J.Kost.) Ghafoor	*	See Ghafoor (2015b).
<i>Cyanthillium cinereum</i> var. <i>linifolium</i> (Blume) Karthik. & Moorthy	*	New naturalised record for WA. See Ghafoor (2015b).
<i>Cyperus unioides</i> R.Br.	P1	New record for WA. M.D. Barrett <i>in litt.</i> (02/08/2016).
<i>Datura leichhardtii</i> Benth. subsp. <i>leichhardtii</i>	*	New naturalised record for WA. See CHAH (2016a).
<i>Diplocyclos palmatus</i> subsp. <i>affinis</i> (Endl.) P.S.Green		New record for WA. See CHAH (2016b).
<i>Diuris brevis</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris carecta</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris littoralis</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris oraria</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris pallescens</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris suffusa</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Diuris tinctoria</i> D.L.Jones & C.J.French		See Jones & French (2016).
<i>Drosera bulbosa</i> subsp. <i>coronata</i> R.P.Gibson	P2	See Gibson (2013).
<i>Dysoxylum acutangulum</i> subsp. <i>foveolatum</i> (Radlk.) Mabb.		New record for WA. See Mabblerley (2013).
<i>Eucalyptus</i> sp. Southern smooth-bark (D. Nicolle & M. French DN 6916)		D. Nicolle <i>in litt.</i> (07/05/2015).
<i>Ficus rubiginosa</i> Vent.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/08/2016).
<i>Flagellaria indica</i> L. var. <i>indica</i>		New record for WA. R.L. Barrett <i>in sched.</i> (24/11/2015).
<i>Geissorrhiza aspera</i> Goldblatt	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (11/10/2016).
<i>Glochidion apodogynum</i> Airy Shaw	P3	New record for WA. M.D. Barrett <i>in litt.</i> (17/06/2016).
<i>Haemodorum</i> sp. East Northcliffe (E.M. Sandiford et al. 2174)		S.D. Hopper <i>in litt.</i> (14/04/2016).
<i>Hakea</i> sp. Great Victoria Desert (L. Cockram LAC 139)	P1	M. Hislop <i>in litt.</i> (20/09/2016).
<i>Hibbertia</i> sp. Geraldton Sandplains (R. Edmiston E 421)		K.R. Thiele <i>in litt.</i> (06/04/2016).
<i>Hibbertia</i> sp. Tenterden (M. Sowry 154)	P2	K.R. Thiele <i>in litt.</i> (06/04/2016).
<i>Hibbertia</i> sp. Toolbrunup (J.R. Wheeler 2504)	P2	K.R. Thiele <i>in litt.</i> (19/09/2016).

New Name	Status	Comments
<i>Lepilaena</i> sp. Wheatbelt (M.T. Collins et al. 265)		T.D. Macfarlane <i>in litt.</i> (13/01/2016).
<i>Limnophila aromatica</i> (Lam.) Merr.	P3	New record for WA. M.D. Barrett <i>in litt.</i> (27/07/2016).
<i>Lipocarpha chinensis</i> (Osbeck) J.Kern	P3	New record for WA. M.D. Barrett <i>in litt.</i> (22/03/2016).
<i>Opuntia dejecta</i> Salm-Dyck	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/02/2016).
<i>Opuntia microdasys</i> (Lehm.) Pfeiff.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/02/2016).
<i>Opuntia puberula</i> Pfeiff.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/02/2016).
<i>Opuntia tomentosa</i> Salm-Dyck	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (25/02/2016).
<i>Ornithogalum umbellatum</i> L.	*	New naturalised record for WA. G.J. Keighery <i>in litt.</i> (08/07/2015).
<i>Prasophyllum</i> sp. Eastern Wheatbelt (C. & D. Woolcock s.n. PERTH 00760846)		A.P. Brown <i>in litt.</i> (16/07/2013).
<i>Prunus armeniaca</i> L.	*	New naturalised record for WA. See Keighery (2011).
<i>Prunus dulcis</i> (Mill.) D.A. Webb	*	New naturalised record for WA. See Keighery (2011).
<i>Prunus persica</i> (L.) Batsch	*	New naturalised record for WA. See Keighery (2011).
<i>Prunus persica</i> var. <i>nucipersica</i> (Suckow) C.K.Schneid.	*	New naturalised record for WA. See Keighery (2011).
<i>Prunus persica</i> (L.) Batsch var. <i>persica</i>	*	New naturalised record for WA. See Keighery (2011).
<i>Rhynchospora brownii</i> Roem. & Schult.	P3	New record for WA. M.D. Barrett <i>in litt.</i> (22/07/2016).
<i>Schoenus</i> sp. Marble Bar (D. Coultas & S. Coultas DCSC-Opp 07)	P1	M. Hislop <i>in litt.</i> (23/06/2016).
<i>Sigesbeckia australiensis</i> D.L.Schulz subsp. <i>australiensis</i>		New record for WA. See Orchard (2015d).
<i>Solanum ossicruentum</i> Martine & J.Cantley		See Martine <i>et al.</i> (2016).
<i>Solanum pallidifolium</i> A.R.Bean		See Bean (2016).
<i>Spiranthes sinensis</i> (Pers.) Ames	P1	New record for WA. M.D. Barrett <i>in litt.</i> (02/08/2016).
<i>Stylidium</i> sp. Mt Bayly (J.A. Wege & C. Wilkins JAW 1986)		J.A. Wege <i>in litt.</i> (28/07/2016).
<i>Tephrosia</i> sp. North West Cape (G. Marsh 81)	P2	R. Butcher <i>in litt.</i> (30/10/2015).
<i>Tetradlea butcheriana</i> A.J.Perkins	P1	See Perkins <i>et al.</i> (2016).
<i>Thelymitra</i> sp. Ongerup (S. Osborne 142)	P2	A.P. Brown <i>in litt.</i> (22/10/2015).

New Name	Status	Comments
<i>Thryptomene</i> sp. Hyden (B.J. Lepschi & L.A. Craven 4477)	P1	B.L. Rye <i>in litt.</i> (10/08/2016).
<i>Thryptomene</i> sp. Warburton (M. Henson & M. Hannart 32433)	P1	B.L. Rye <i>in litt.</i> (14/01/2016).
<i>Thysanotus</i> sp. Coastal plain (N.H. Brittan 66/63)		T.D. Macfarlane <i>in litt.</i> (13/01/2016).
<i>Utricularia byrneana</i> R.W.Jobson & Baleeiro	P1	See Jobson & Baleeiro (2015).
<i>Utricularia circumvoluta</i> P.Taylor	P1	New record for WA. M.D. Barrett <i>in litt.</i> (02/08/2016).
<i>Utricularia wannanii</i> R.W.Jobson & Baleeiro	P2	See Jobson & Baleeiro (2015).
<i>Verbesina encelioides</i> (Cav.) A.Gray var. <i>encelioides</i>	*	New naturalised record for WA. See Orchard (2015b).
<i>Verticordia</i> sp. Dundas (C.A. Gardner 2848)	P1	B.L. Rye <i>in litt.</i> (27/10/2015).

**Table 2.** Changes to existing entries in Western Australia's vascular plant census during 2016. Excluded name = a name used in the botanical literature that refers to a taxon never occurring in WA; misapplied name = a name used in the botanical literature but now considered to refer to one or more different WA taxa; nomenclatural synonym = a superseded name based on the same type specimen as the accepted name—the epithet is usually transferred to a different genus name or rank; taxonomic synonym = a superseded name based on a different type specimen to the accepted name; orthographic variant = mis-spelling of a name in original publication; *in litt.* = in correspondence; *in sched.* = on herbarium sheet/label. Status: \* = naturalised; T, P1–P4 = Department of Parks and Wildlife Conservation Codes for Western Australian flora (Jones 2015; Western Australian Herbarium 1998–).

Old Name	New Name	Status	Comments
<i>Acacia</i> sp. Barklys (J.L. Egan 124)	<i>Acacia citriodora</i> Kodela & Maslin		Taxon formally published. See Kodela & Maslin (2016).
<i>Acacia</i> sp. Pilbara (S. van Leeuwen 690)	<i>Acacia kempeana</i> F.Muell.		Name synonymised. B.R. Maslin <i>in sched.</i> (Dec. 2006).
<i>Acacia spectra</i> Lewington & Maslin	<i>Acacia spectrum</i> Lewington & Maslin	P2	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Acacia verricula</i> R.S.Cowan & Maslin	<i>Acacia verriculum</i> R.S.Cowan & Maslin		Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Acetosa sagittata</i> (Thunb.) L.A.S.Johnson & B.G.Briggs	<i>Rumex sagittatus</i> Thunb.	*	Nomenclatural synonym. See Schuster <i>et al.</i> (2015).
<i>Acetosa vesicaria</i> (L.) A.Love	<i>Rumex vesicarius</i> L.	*	Nomenclatural synonym. See Schuster <i>et al.</i> (2015).
<i>Acetosella vulgaris</i> Fourr.	<i>Rumex acetosella</i> L.	*	Nomenclatural synonym. See Schuster <i>et al.</i> (2015).
<i>Allocasuarina</i> sp. Boxwood Hill (S. Barrett 2090)	<i>Allocasuarina anfractuosa</i> Wege & S.R.Barrett	P1	Taxon formally published. See Wege & Barrett (2016).
<i>Ambrosia artemisiifolia</i> L.	n/a	*	Name made current. Taxon reinstated. See Orchard (2015c).
<i>Anisomeles malabarica</i> (L.) R.Br.	n/a		Excluded taxon. See Bean (2015).

Old Name	New Name	Status	Comments
<i>Anisomeles salviifolia</i> R.Br.	n/a		Excluded taxon. See Bean (2015).
<i>Apodasmia ceramophila</i> B.G.Briggs & L.A.S.Johnson ms	<i>Apodasmia ceramophila</i> B.G.Briggs & L.A.S.Johnson		Taxon formally published. See Briggs & Johnson (2014).
<i>Astroloma baxteri</i> DC.	<i>Brachyloma baxteri</i> (DC.) Puente-Lel.		Nomenclatural synonym. See Puente-Lelièvre <i>et al.</i> (2016).
<i>Astus duomilius</i> Trudgen & Rye	<i>Astus duomilia</i> Trudgen & Rye	P1	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Atriplex</i> sp. Yeelirrie Station (L. Trotter & A. Douglas LCH 25025)	<i>Atriplex yeelirrie</i> K.A.Sheph. & K.R.Thiele	T	Taxon formally published. See Shepherd <i>et al.</i> (2015).
<i>Austrodolichos</i> sp. Erubescens (A.A. Mitchell 3371)	<i>Austrodolichos errabundus</i> (M.B.Scott) Verdc.		Name synonymised. R.L. Barrett <i>in sched.</i> (07/03/2016).
<i>Baeckea preissiana</i> (Schauer) Druce	<i>Tetrapora preissiana</i> Schauer		Nomenclatural synonym. See Rye & Trudgen (2012).
<i>Beaufortia interstans</i> F.Muell.	<i>Beaufortia puberula</i> Turcz.		Taxonomic synonym. See Burbidge (2016).
<i>Beaufortia micrantha</i> Schauer var. <i>micrantha</i>	<i>Beaufortia micrantha</i> Schauer		Nomenclatural synonym. No varieties recognised. See Burbidge (2016).
<i>Beaufortia micrantha</i> var. <i>puberula</i> Benth.	<i>Beaufortia puberula</i> Turcz.		Taxonomic synonym. See Burbidge (2016).
<i>Beaufortia</i> sp. column (J.S. Beard 8119)	<i>Beaufortia burbridgeae</i> A.A.Burb.	P3	Taxon formally published. See Burbidge (2016).
<i>Blechnum indicum</i> Burm.f.	<i>Telmatoblechnum indicum</i> (Burm.f.) Perrie, D.J.Ohlsen & Brownsey	P1	Nomenclatural synonym. See Perrie <i>et al.</i> (2014).
<i>Brachyachne ambigua</i> Ohwi	<i>Cynodon ambiguus</i> (Ohwi) P.M.Peterson	*	Nomenclatural synonym. See Peterson <i>et al.</i> (2015).
<i>Brachyachne convergens</i> (F.Muell.) Stapf	<i>Cynodon convergens</i> F.Muell.		Nomenclatural synonym. See Peterson <i>et al.</i> (2015).
<i>Brachyachne prostrata</i> C.A.Gardner & C.E.Hubb.	<i>Cynodon prostratus</i> (C.A.Gardner & C.E.Hubb.) P.M.Peterson		Nomenclatural synonym. See Peterson <i>et al.</i> (2015).
<i>Brachyachne tenella</i> (R.Br.) C.E.Hubb.	<i>Cynodon tenellus</i> R.Br.		Nomenclatural synonym. See Peterson <i>et al.</i> (2015).
<i>Brachyscome tatei</i> J.M.Black	n/a		Name made current. Taxon reinstated. M. Hislop <i>in sched.</i> (05/07/2016).
<i>Caladenia incensa</i> Hopper & A.P.Br.	<i>Caladenia incensum</i> Hopper & A.P.Br.		Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Chrysanthemum coronarium</i> L.	<i>Glebionis coronaria</i> (L.) Spach	*	Nomenclatural synonym. See Thompson (2015).
<i>Chrysanthemum segetum</i> L.	<i>Glebionis segetum</i> (L.) Fourr.	*	Nomenclatural synonym. See Thompson (2015).
<i>Chrysocephalum semipapposum</i> (Labill.) Steetz	n/a		Name made current. Taxon reinstated. See Wilson (2016).
<i>Chrysocephalum</i> sp. Kimberley (A.S. George 13193)	<i>Chrysocephalum apiculatum</i> subsp. <i>curvifolium</i> (Domin) Paul G.Wilson	P3	Name synonymised. See Wilson (2016).
<i>Chrysocephalum</i> sp. Pilbara (H. Demarz 2852)	<i>Chrysocephalum apiculatum</i> subsp. <i>pilbarensense</i> Paul G.Wilson		Taxon formally published. See Wilson (2016).

Old Name	New Name	Status	Comments
<i>Cicer arietinum</i> L.	n/a	*	Name made current. Taxon reinstated. G.J. Keighery <i>in litt.</i> (14/09/2015).
<i>Crinum angustifolium</i> R.Br.	<i>Crinum arenarium</i> Herb.		Taxonomic synonym. See Barrett & Barrett (2015).
<i>Dampiera</i> sp. Central Wheatbelt (L.W. Sage, F. Hort, C.A. Hollister LWS 2321)	<i>Dampiera glabrescens</i> Benth.	P1	Name synonymised. See Hislop & Shepherd (2016).
<i>Diuris</i> sp. Darling Scarp (G.B. Brockman 1118)	<i>Diuris ostrina</i> D.L.Jones & C.J.French		Name synonymised. See Jones & French (2016).
<i>Dysphania</i> sp. Fortescue Marsh (A. Markey & S. Dillon FM 9709)	<i>Dysphania congestiflora</i> S.J.Dillon & A.S.Markey	P3	Taxon formally published. See Dillon & Markey (2016).
<i>Emex australis</i> Steinh.	<i>Rumex hypogaeus</i> T.M.Schust. & Reveal	*	Nomenclatural synonym. See Schuster <i>et al.</i> (2015).
<i>Emex spinosa</i> (L.) Campd.	<i>Rumex spinosus</i> L.	*	Nomenclatural synonym. See Schuster <i>et al.</i> (2015).
<i>Eremophila</i> sp. Mt Augustus (B. Buirchell BB 205)	<i>Eremophila buirchellii</i> A.P.Br.	P2	Taxon formally published. See Brown & Davis (2016).
<i>Eremophila</i> sp. Parmango Road (J. Start D5-46)	<i>Eremophila calcicola</i> R.W.Davis	P2	Taxon formally published. See Brown & Davis (2016).
<i>Eucalyptus calycogona</i> subsp. <i>miracula</i> D.Nicolle & M.E.French	<i>Eucalyptus calycogona</i> subsp. <i>miraculum</i> D.Nicolle & M.E.French		Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Eucalyptus medialis</i> Brooker & Hopper	<i>Eucalyptus hebetifolia</i> Brooker & Hopper		Taxonomic synonym. D. Nicolle <i>in litt.</i> (13/11/2014).
<i>Eucalyptus sargentii</i> subsp. <i>onesia</i> D.Nicolle	<i>Eucalyptus sargentii</i> subsp. <i>onesis</i> D.Nicolle	P3	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Eucalyptus subluccida</i> L.A.S.Johnson & K.D.Hill	<i>Eucalyptus eremicola</i> subsp. <i>peeneri</i> (Blakely) D.Nicolle		Taxonomic synonym. See Nicolle <i>et al.</i> (2005).
<i>Eucalyptus surgens</i> Brooker & Hopper	<i>Eucalyptus scyphocalyx</i> (Benth.) Maiden & Blakely		Taxonomic synonym. See Nicolle <i>et al.</i> (2012).
<i>Eucalyptus trichopoda</i> L.A.S.Johnson & K.D.Hill ms	<i>Eucalyptus longissima</i> D.Nicolle		Name synonymised. D. Nicolle <i>in litt.</i> (02/08/2015).
<i>Goodenia</i> sp. Little Sandy Desert (A.S. Mitchell 989)	<i>Goodenia iyouta</i> Carolin		Name synonymised. See Hislop & Shepherd (2016).
<i>Harperia confertospicata</i> (Steud.) B.G.Briggs & L.A.S.Johnson	<i>Desmocladius confertospicatus</i> (Steud.) B.G.Briggs		Nomenclatural synonym. See Briggs (2014b).
<i>Harperia eyreana</i> B.G.Briggs & L.A.S.Johnson	<i>Desmocladius eyreanus</i> (B.G.Briggs & L.A.S.Johnson) B.G.Briggs	P2	Nomenclatural synonym. See Briggs (2014b).
<i>Harperia ferruginipes</i> Meney & Pate	<i>Desmocladius ferruginipes</i> (Meney & Pate) B.G.Briggs	P1	Nomenclatural synonym. See Briggs (2014b).
<i>Harperia lateriflora</i> W.Fitzg.	<i>Desmocladius lateriflorus</i> (W.Fitzg.) B.G.Briggs		Nomenclatural synonym. See Briggs (2014b).
<i>Hemigenia</i> sp. Gibson (R. Coveny 7893 & B.R. Maslin)	<i>Hemigenia tichbonii</i> K.R.Thiele & G.R.Guerin	P1	Taxon formally published. See Thiele & Guerin (2016).
<i>Hemigenia</i> sp. Yuna (A.C. Burns 95)	<i>Hemigenia yalgensis</i> G.R.Guerin		Taxon formally published. See Guerin (2015).

Old Name	New Name	Status	Comments
<i>Hibbertia abyssa</i> Wege & K.R.Thiele	<i>Hibbertia abyssus</i> Wege & K.R.Thiele	T	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Indigofera brevidens</i> Benth.	n/a		Excluded taxon. Peter G. Wilson <i>in litt.</i> (02/02/2016).
<i>Ipomoea</i> sp. A Kimberley Flora (L.J. Pen 84)	<i>Ipomoea tolmerana</i> subsp. <i>occidentalis</i> R.W.Johnson	P1	Taxon formally published. See Johnson (2012).
<i>Ipomoea</i> sp. Kununurra (T.E.Aplin 6307)	<i>Ipomoea limosa</i> R.W.Johnson		Taxon formally published. See Johnson (2012).
<i>Keraudrenia adenogyna</i> C.F.Wilkins ms	<i>Seringia adenogyna</i> C.F.Wilkins	P3	Taxon formally published. See Wilkins & Whitlock (2016).
<i>Keraudrenia cacaobrunnea</i> C.F.Wilkins ms	<i>Seringia cacaobrunnea</i> C.F.Wilkins		Taxon formally published. See Wilkins & Whitlock (2016).
<i>Keraudrenia cacaobrunnea</i> subsp. <i>undulata</i> C.F.Wilkins ms	<i>Seringia undulata</i> C.F.Wilkins	P1	Taxon formally published. See Wilkins & Whitlock (2016).
<i>Keraudrenia exastia</i> C.F.Wilkins	<i>Seringia exastia</i> (C.F.Wilkins) C.F.Wilkins & Whitlock	T	Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia hermanniifolia</i> J.Gay	<i>Seringia hermanniifolia</i> (J.Gay) F.Muell.		Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia integrifolia</i> Steud.	<i>Seringia integrifolia</i> (Steud.) F.Muell.		Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia katatona</i> C.F.Wilkins	<i>Seringia katatona</i> (C.F.Wilkins) C.F.Wilkins & Whitlock	P3	Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia nephrosperma</i> (F.Muell.) F.Muell.	<i>Seringia nephrosperma</i> F.Muell.		Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia saxatilis</i> C.F.Wilkins ms	<i>Seringia saxatilis</i> C.F.Wilkins	P2	Taxon formally published. See Wilkins & Whitlock (2016).
<i>Keraudrenia velutina</i> Steetz	<i>Seringia velutina</i> (Steetz) F.Muell.		Nomenclatural synonym. See Wilkins & Whitlock (2016).
<i>Keraudrenia velutina</i> subsp. <i>elliptica</i> C.F.Wilkins ms	<i>Seringia elliptica</i> C.F.Wilkins		Taxon formally published. See Wilkins & Whitlock (2016).
<i>Kulinia eludens</i> B.G.Briggs & L.A.S.Johnson	<i>Desmocladus eludens</i> (B.G.Briggs & L.A.S.Johnson) B.G.Briggs	P2	Nomenclatural synonym. See Briggs (2014b).
<i>Lasiopetalum trichantherum</i> K.A.Sheph. & C.F.Wilkins	<i>Lasiopetalum trichanthera</i> K.A.Sheph. & C.F.Wilkins	P2	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Latrobea pinnacula</i> Chappill & C.F.Wilkins	<i>Latrobea pinnaculum</i> Chappill & C.F.Wilkins	P2	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Lepidosperma brunonianum</i> Nees	n/a		Excluded taxon. See Barrett & Wilson (2012).
<i>Leptocarpus elegans</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus elegans</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Leptocarpus elegans</i> B.G.Briggs	<i>Leptocarpus trisepalus</i> (Nees) B.G.Briggs		Taxonomic synonym. See Briggs (2015).
<i>Leucochrysum fitzgibbonii</i> (F.Muell.) Paul G.Wilson	<i>Waitzia fitzgibbonii</i> (F.Muell.) X.A.Weber & Schmidt-Leb.		Nomenclatural synonym. See Weber & Schmidt-Lebuhn (2015).
<i>Leucopogon</i> sp. Boyagin (M. Hislop 2825)	<i>Leucopogon cordatus</i> Sond.		Name synonymised. See Hislop & Shepherd (2016).
<i>Lindernia plantaginea</i> (F.Muell.) F.Muell.	<i>Hemiarrhena plantaginea</i> (F.Muell.) Benth.		Nomenclatural synonym. See Fischer <i>et al.</i> (2013).

Old Name	New Name	Status	Comments
<i>Logania biloba</i> B.J.Conn	<i>Orianthera biloba</i> (B.J.Conn) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania callosa</i> F.Muell.	<i>Orianthera callosa</i> (F.Muell.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania campanulata</i> R.Br.	<i>Orianthera campanulata</i> (R.Br.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania centralis</i> B.J.Conn	<i>Orianthera centralis</i> (B.J.Conn) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania exilis</i> B.J.Conn	<i>Orianthera exilis</i> (B.J.Conn) C.S.P.Foster & B.J.Conn	P2	Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania flaviflora</i> F.Muell.	<i>Orianthera flaviflora</i> (F.Muell.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania judithiana</i> B.J.Conn	<i>Orianthera judithiana</i> (B.J.Conn) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania nuda</i> F.Muell.	<i>Orianthera nuda</i> (F.Muell.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania serpyllifolia</i> R.Br.	<i>Orianthera serpyllifolia</i> (R.Br.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania serpyllifolia</i> subsp. <i>angustifolia</i> (Benth.) B.J.Conn	<i>Orianthera serpyllifolia</i> subsp. <i>angustifolia</i> (Benth.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania serpyllifolia</i> R.Br. subsp. <i>serpyllifolia</i>	<i>Orianthera serpyllifolia</i> (R.Br.) C.S.P.Foster & B.J.Conn subsp. <i>serpyllifolia</i>		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania spermacoceae</i> F.Muell.	<i>Orianthera spermacoceae</i> (F.Muell.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania tortuosa</i> D.A.Herb.	<i>Orianthera tortuosa</i> (D.A.Herb.) C.S.P.Foster & B.J.Conn		Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Logania wendyae</i> Cranfield & Keighery	<i>Orianthera wendyae</i> (Cranfield & Keighery) C.S.P.Foster & B.J.Conn	P1	Nomenclatural synonym. See Foster <i>et al.</i> (2014).
<i>Luffa aegyptiaca</i> var. <i>leiocarpa</i> (Naud.) Heiser & E.E.Schill.	<i>Luffa aegyptiaca</i> Mill.		Taxonomic synonym. No varieties recognised. See CHAH (2016c).
<i>Luffa graveolens</i> Roxb.	<i>Luffa saccata</i> I.Telford		Misapplied name. See CHAH (2016d).
<i>Lycopersicon esculentum</i> Mill.	<i>Solanum lycopersicum</i> L.	*	Taxonomic synonym. See Tepe <i>et al.</i> (2016).
<i>Malleostemon</i> sp. Ajana (M.E. Trudgen 21715)	<i>Malleostemon uniflorus</i> Rye		Taxon formally published. See Rye (2016).
<i>Malleostemon</i> sp. Cooloomia (S.D. Hopper 1353)	<i>Malleostemon microphyllus</i> Rye & Trudgen	P2	Taxon formally published. See Rye (2016).
<i>Malleostemon</i> sp. Erangy Springs (M.E. Trudgen 12030)	<i>Malleostemon nephroideus</i> Rye	P3	Name synonymised. See Rye (2016).
<i>Malleostemon</i> sp. Hardabutt Rapids (D. Bellairs 1654A)	<i>Malleostemon pentagonus</i> Rye & Trudgen	P3	Taxon formally published. See Rye (2016).
<i>Malleostemon</i> sp. Junga Dam (D. Bellairs 942)	<i>Malleostemon pustulatus</i> Rye	P2	Taxon formally published. See Rye (2016).
<i>Malleostemon</i> sp. Kalbarri (L.A. Craven 7083)	<i>Malleostemon hursthousei</i> (W.Fitzg.) J.W.Green		Name synonymised. See Rye (2016).

Old Name	New Name	Status	Comments
<i>Malleostemon</i> sp. Mullewa (P. Winson B7365)	<i>Malleostemon nephroideus</i> Rye	P3	Name synonymised. See Rye (2016).
<i>Malleostemon</i> sp. Nerren Nerren (A. Payne 360)	<i>Malleostemon nerrenensis</i> Rye & Trudgen	P1	Taxon formally published. See Rye (2016).
<i>Malleostemon</i> sp. Yerina (S.J. Patrick 2728)	<i>Malleostemon costatus</i> Rye & Trudgen	P2	Taxon formally published. See Rye (2016).
<i>Meeboldina cana</i> (Nees) B.G.Briggs & L.A.S.Johnson	<i>Leptocarpus canus</i> Nees		Nomenclatural synonym. See Briggs (2014a).
<i>Meeboldina coangustata</i> (Nees) B.G.Briggs & L.A.S.Johnson	<i>Leptocarpus coangustatus</i> Nees		Nomenclatural synonym. See Briggs (2014a).
<i>Meeboldina crassipes</i> (Pate & Meney) B.G.Briggs & L.A.S.Johnson	<i>Leptocarpus crassipes</i> Pate & Meney	P3	Nomenclatural synonym. See Briggs (2014a).
<i>Meeboldina crebriculmis</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus crebriculmis</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina decipiens</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus decipiens</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina decipiens</i> subsp. <i>depilata</i> B.G.Briggs & L.A.S.Johnson ms	<i>Leptocarpus depilatus</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina denmarkica</i> Suess.	<i>Leptocarpus denmarkicus</i> (Suess.) B.G.Briggs		Nomenclatural synonym. See Briggs (2014a).
<i>Meeboldina kraussii</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus kraussii</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina roycei</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus roycei</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina scariosa</i> (R.Br.) B.G.Briggs & L.A.S.Johnson	<i>Leptocarpus scariosus</i> R.Br.		Nomenclatural synonym. See Briggs (2014a).
<i>Meeboldina tephрина</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus tephrinus</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Meeboldina thysanantha</i> L.A.S.Johnson & B.G.Briggs ms	<i>Leptocarpus thysananthus</i> B.G.Briggs		Taxon formally published. See Briggs (2014a).
<i>Memecylon pauciflorum</i> Blume var. <i>pauciflorum</i>	<i>Memecylon pauciflorum</i> Blume		Nomenclatural synonym. No varieties recognised. See Wijedasa & Hughes (2012).
<i>Micromyrtus uniovula</i> Rye	<i>Micromyrtus uniovulum</i> Rye	P2	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Microseris lanceolata</i> (Walp.) Sch.Bip.	<i>Microseris walteri</i> Gand.	P3	Misapplied name. See Walsh (2016).
<i>Microseris scapigera</i> (A.Cunn.) Sch.Bip.	n/a		Excluded taxon. See Sneddon (2015).
<i>Morinda canthoides</i> (F.Muell.) Halford & R.J.F.Hend.	<i>Gynochthodes canthoides</i> (F.Muell.) Razafim. & B.Bremer	P2	Nomenclatural synonym. See Razafimandimbison & Bremer (2011).
<i>Morinda jasminoides</i> A.Cunn.	<i>Gynochthodes jasminoides</i> (A.Cunn.) Razafim. & B.Bremer	P3	Nomenclatural synonym. See Razafimandimbison & Bremer (2011).
<i>Murchisonia fragrans</i> Brittan	<i>Thysanotus fragrans</i> (Brittan) Sirisena, Conran & T.Macfarlane	P2	Nomenclatural synonym. See Sirisena <i>et al.</i> (2016).
<i>Murchisonia volubilis</i> Brittan	<i>Thysanotus exfimbriatus</i> Sirisena, Conran & T.Macfarlane		Nomenclatural synonym. See Sirisena <i>et al.</i> (2016).

Old Name	New Name	Status	Comments
<i>Onychosepalum laxiflorum</i> Steud.	<i>Desmocladius laxiflorus</i> (Steud.) B.G.Briggs		Nomenclatural synonym. See Briggs (2014b).
<i>Onychosepalum microcarpum</i> Meney & Pate	<i>Desmocladius microcarpus</i> (Meney & Pate) B.G.Briggs	P2	Nomenclatural synonym. See Briggs (2014b).
<i>Onychosepalum nodatum</i> B.G.Briggs & L.A.S.Johnson	<i>Desmocladius nodatus</i> (B.G.Briggs & L.A.S.Johnson) B.G.Briggs	P3	Nomenclatural synonym. See Briggs (2014b).
<i>Orobanche australiana</i> F.Muell.	<i>Orobanche cernua</i> var. <i>australiana</i> (F.Muell.) Beck	P3	Nomenclatural synonym. See Barker (1999).
<i>Orobanche cernua</i> Loebl.	n/a		Name made current. Taxon reinstated. W.R. Barker <i>in litt.</i> (03/06/2016).
<i>Pavonia hastata</i> Cav.	n/a	*	Name made current. Taxon reinstated. See Hussey <i>et al.</i> (2007).
<i>Petunia</i> × <i>hybrida</i> Vilm.	<i>Petunia</i> × <i>atkinsiana</i> (Sweet) W.H.Baxter	*	Taxonomic synonym. See GRIN (2011).
<i>Philotheca</i> sp. Bremer Range (E. Adams EA 659)	<i>Philotheca gardneri</i> (Paul G.Wilson) Paul G.Wilson		Name synonymised. See Hislop & Shepherd (2016).
<i>Phyllanthus reticulatus</i> Poir.	<i>Phyllanthus baccatus</i> Benth.		Misapplied name. See Barrett & Telford (2015).
<i>Phyllanthus reticulatus</i> var. <i>glaber</i> Müll.Arg.	<i>Phyllanthus baccatus</i> Benth.		Misapplied name. R.L. Barrett & I.R.H. Telford <i>in sched.</i> (23/11/2015).
<i>Polyalthia australis</i> (Benth.) Jessup	<i>Monoon australe</i> (Benth.) B.Xue & R.M.K.Saunders		Nomenclatural synonym. See Xue <i>et al.</i> (2012).
<i>Prasophyllum giganteum</i> subsp. <i>fuligineum</i> R.J.Bates ms	<i>Prasophyllum</i> sp. Eastern Wheatbelt (C. & D. Woolcock s.n. PERTH 00760846)		Name synonymised. To align with CHAH phrase name protocols. A.P. Brown <i>in litt.</i> (16/07/2013).
<i>Scaevola</i> sp. Lake Cairlocup (K. Newbey 9834)	<i>Velleia exigua</i> (F.Muell.) Carolin	P2	Name synonymised. See Hislop & Shepherd (2016).
<i>Senna</i> sp. Millstream (E. Leyland s.n. 30/8/1990)	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> (F.Muell.) Randell		Name synonymised. See Hislop & Shepherd (2016).
<i>Stenotalis ramosissima</i> (Gilg) B.G.Briggs & L.A.S.Johnson	<i>Leptocarpus scoparius</i> B.G.Briggs		Nomenclatural synonym. See Briggs (2014a).
<i>Stylidium planirosulum</i> Wege	<i>Stylidium planirosula</i> Wege		Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Taraxacum officinale</i> F.H.Wigg.	<i>Taraxacum khatoonae</i> Abedin	*	Misapplied name. See Scarlett (2015).
<i>Tecticornia doleiformis</i> (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson	<i>Tecticornia doliiformis</i> (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson		Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Tecticornia mellaria</i> K.A.Sheph.	<i>Tecticornia mellarium</i> K.A.Sheph.	P1	Orthographic variant. A.S. George <i>in litt.</i> (02/03/2016).
<i>Tetragonia tetragonoides</i> Baker	<i>Tetragonia tetragonoides</i> (Pall.) Kuntze		Orthographic variant. See CHAH (2016e).
<i>Trachynia distachya</i> (L.) Link	<i>Brachypodium distachyon</i> (L.) P.Beauv.	*	Nomenclatural synonym. See Henwood & Weiller (2009).
<i>Trichodesma zeylanicum</i> var. <i>latisepalum</i> Benth.	<i>Trichodesma zeylanicum</i> var. <i>latisepalum</i> F.Muell.		Orthographic variant. See CHAH (2016f).
<i>Vigna</i> sp. rockpiles (R. Butcher <i>et al.</i> RB 1400)	<i>Vigna triodiophila</i> A.E.Holland & R.Butcher	P3	Taxon formally published. See Holland & Butcher (2016).

Old Name	New Name	Status	Comments
<i>Xanthium occidentale</i> Bertol.	n/a	*	Name made current. Taxon reinstated. See Orchard (2015c).
<i>Xanthium strumarium</i> L.	n/a	*	Excluded taxon. See Orchard (2015c).

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## SHORT COMMUNICATION

**Synonymisation of three Western Australian taxa within *Ptilotus* (Amaranthaceae)**

*Ptilotus gomphrenoides* F.Muell. ex Benth. is a variable species found in the Pilbara, Gascoyne, Carnarvon and Murchison bioregions of Western Australia. It currently comprises three varieties, var. *gomphrenoides*, var. *conglomeratus* (Farmar) Benl and var. *roseo-albus* (Farmar) Benl. The two latter taxa, having been formerly assigned to *P. roseo-albus* Farmar (Farmar 1905), were combined into *P. gomphrenoides* by Benl (1962), who remarked that *P. roseo-albus* could not be sustained as a distinct species and that the features Farmar used to characterise it, such as narrower and shortly pedunculate spikes and a denser indumentum on the exterior surface of the outer tepals, were common characteristics of *P. gomphrenoides*.

Benl separated the three varieties of *P. gomphrenoides* according to the degree of stem branching, whether the spikes were solitary or clustered, and spike length. These characters, however, do not withstand scrutiny with the increased number of collections now available for study. The degree of branching merges imperceptibly between all three varieties. Whether the spikes are mostly solitary or clustered varies greatly between specimens and even on individual specimens. Spike length is rarely a useful character in *Ptilotus* R.Br., as the spikes are indeterminate and their length is dependent upon environmental and seasonal factors. Recognition of var. *conglomeratus* and var. *roseo-albus*, both of which are known from only a small number of collections scattered across the range of *P. gomphrenoides*, serves to confuse the taxonomy of *Ptilotus*. We do not regard them as representing distinct lineages, but rather variation already included within *P. gomphrenoides* var. *gomphrenoides*. We therefore choose to synonymise both varieties under *P. gomphrenoides*.

***Ptilotus gomphrenoides*** F.Muell. ex Benth., *Fl. Austral.* 5: 244 (1870). Type: ‘Hamersley Range, N.W. coast, F. Gregory’s Expedition’, *F. Mueller s.n.* (syn: K 000357029 image!, MEL 2281815 image!).

*Ptilotus gomphrenoides* var. *roseo-albus* (Farmar) Benl, *Mitt. Bot. Staatssamml. München* 4: 277 (1962), syn. nov. *Ptilotus roseo-albus* Farmar var. *roseo-albus*, *Bull. Herb. Boissier sér.* 2, 5: 1090 (1905). Type: ‘N.-W. Division, W. Australia, E. Clement, 1897’ [between the Ashburton and De Grey rivers, Western Australia, 1897, *E. Clement s.n.*] (syn: K 000357024 image!, K 000357025 image!, K 000357026 image!, K 000357027 image!).

*Ptilotus gomphrenoides* var. *conglomeratus* (Farmar) Benl, *Mitt. Bot. Staatssamml. München* 4: 278 (1962), syn. nov. *Ptilotus roseo-albus* var. *conglomeratus* Farmar, *Bull. Herb. Boissier, sér.* 2, 5: 1090 (1905). Type: ‘N.-W. Division, W. Australia, E. Clement, 1897’ [between the Ashburton and De Grey rivers, Western Australia, 1897, *E. Clement s.n.*] (*holo*: K 000357028 image!).

***Ptilotus* sp. Kennedy Range (A.P. Brown 4276) = *Ptilotus polakii* F.Muell. subsp. *polakii***

*Voucher specimen.* WESTERN AUSTRALIA: 28.9 km W of Mount Sandiman Homestead, adj. N end of Kennedy Range National Park, 27 June 2006, *A.P. Brown 4276* (PERTH!).

*Notes.* *Ptilotus* sp. Kennedy Range is known only from two specimens at PERTH, the voucher and a second collection from nearby (PERTH 04151321). The precise collection locality of the voucher specimen was inaccessible in 2011 during recollection attempts; however, a collection was made from c. 350 m away in the same habitat. This specimen (PERTH 08321086) was later identified as *P. polakii*, but could not be placed in either subsp. *polakii* or subsp. *justus* Lally, because of its intermediate characters. *Ptilotus polakii* subsp. *justus* differs from the typical subspecies in the following characters: tepal apices glabrous in uppermost 1–2 mm (vs 3–5 mm), bracts conspicuously shorter than the bracteoles (vs  $\pm$  equal in length), and tepals shorter than 13 mm long (vs up to 18 mm long) (Lally 2009).

We have compared the two specimens of *P. sp.* Kennedy Range to all material of *P. polakii* housed at PERTH and conclude that they differ only in their densely hairy ovaries. The presence or absence of hairs on the ovary can be diagnostic for species of *Ptilotus*, although infraspecific variation exists in some taxa; the ovaries of *P. polakii* are usually glabrous but may have a few scattered hairs. As such, we do not think this character alone is sufficient for the recognition of *P. sp.* Kennedy Range as distinct from *P. polakii*, and recommend *P. sp.* Kennedy Range be removed from Western Australia's vascular plant census (Western Australian Herbarium 1998–). The two specimens currently filed under this name have bracts c. equal in length to the bracteoles, and tepals 14.5–16.5 mm long that are glabrous at the apices for 3–7 mm length, and will be included in *P. polakii* subsp. *polakii*.

*Ptilotus* sp. Kennedy Range is currently listed as a Priority Two taxon under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Jones 2015). As this name is being removed from the state's vascular plant census, this listing is no longer warranted.

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## SHORT COMMUNICATION

***Hibiscus campanulatus* (Malvaceae), a new and rare species from the Pilbara bioregion, Western Australia**

***Hibiscus campanulatus*** A.J.Perkins, *sp. nov.*

*Type*: north-east of Paraburdoo, Western Australia [precise locality withheld for conservation reasons], 24 November 2012, *S. Reiffer s.n. (holo*: PERTH 08461228; *iso*: CANB).

*Hibiscus* sp. Canga (P.J.H. Hurter & J. Naaykens 11013), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 30 September 2016].

Woody *shrub* 1.8–3.0 m tall. *Branchlets* densely covered with fine, white to cream to pale rusty brown stellate hairs 0.4–1.5 mm long, which are sparsely interspersed with simple hairs 0.4–0.5 mm long; hairs often covered with small droplets of resin. *Stipules* more or less persistent, 10–20 mm long, green when young turning brown with age. *Leaves* simple, villous with mostly stellate resinous hairs sparsely interspersed with simple hairs, distinctly petiolate; petiole terete, indistinctly grooved to striate, 15–45 mm long; lamina deltoid to ovate, 30–90 mm long, 30–80 mm wide; base shallow to distinctly cordate; margin serrate to biserrate; apex acute, the adaxial surface slightly darker green than abaxial surface; veins ending at the margin, tertiary venation slightly sunken on adaxial surface, lateral and secondary venation more prominent and raised on abaxial surface. *Flowers* solitary in leaf axils, chasmogamous, functionally monoecious; pedicels 15–55 mm long, with an articulation 10–15 mm from the base of the calyx, indumentum similar to that of the young stems and petioles. *Epicalyx* 6–8-segmented, 7.5–12.0 mm long, 4–6 mm wide, segments lanceolate to elliptic, acute to obtuse, free or connate near the base, shorter than the calyx, spreading to recurved; midvein distinct on abaxial surface, raised. *Calyx* at anthesis 25–40 mm long, 4–7 mm wide, venation distinct on abaxial surface, raised, 1–3-nerved, densely covered with stellate hairs and sparsely interspersed with simple hairs, adaxial surface densely covered with simple hairs only. *Corolla* campanulate with 5 free petals, petals obdeltoid, 35–42 mm long, 15–22 mm wide, white through to pale lilac, basal petal spot absent. *Staminal column* 22–26 mm long with the stamens distributed along the distal 15–19 mm of the column; staminal filaments 1.5–3.0 mm long; anthers pink; pollen yellow. *Style* exerted 3–6 mm beyond the apex of the staminal column; style branches 5, 2–4 mm long; stigmas capitate, 0.8–1.2 mm across, stigmatic hairs 0.1–0.4 mm long. *Ovary* sparsely covered with simple hairs at anthesis. *Fruit* a capsule, hairy, 11–13 mm long. *Seed* 3.5–4.0 mm long, 1.8–2.2 mm wide, reniform, densely covered with white simple hairs. (Figure 1)

*Diagnostic features.* *Hibiscus campanulatus* is distinguished from all other members of the genus by the following combination of characters: woody shrub to 3 m high, indumentum of resinous stellate hairs and simple glandular hairs covering all parts except corolla, deltoid to ovate leaves with cordate bases and serrate to biserrate margins, flowers solitary in leaf axils, epicalyx lobes lanceolate to elliptic in shape and distinctly spreading to recurved, calyx with raised venation distinct on abaxial surface (1–3-nerved), adaxial surface of calyx only covered with simple hairs, corolla campanulate and with 5 free, obdeltoid petals that are white through to pale lilac but lacking a basal petal spot.

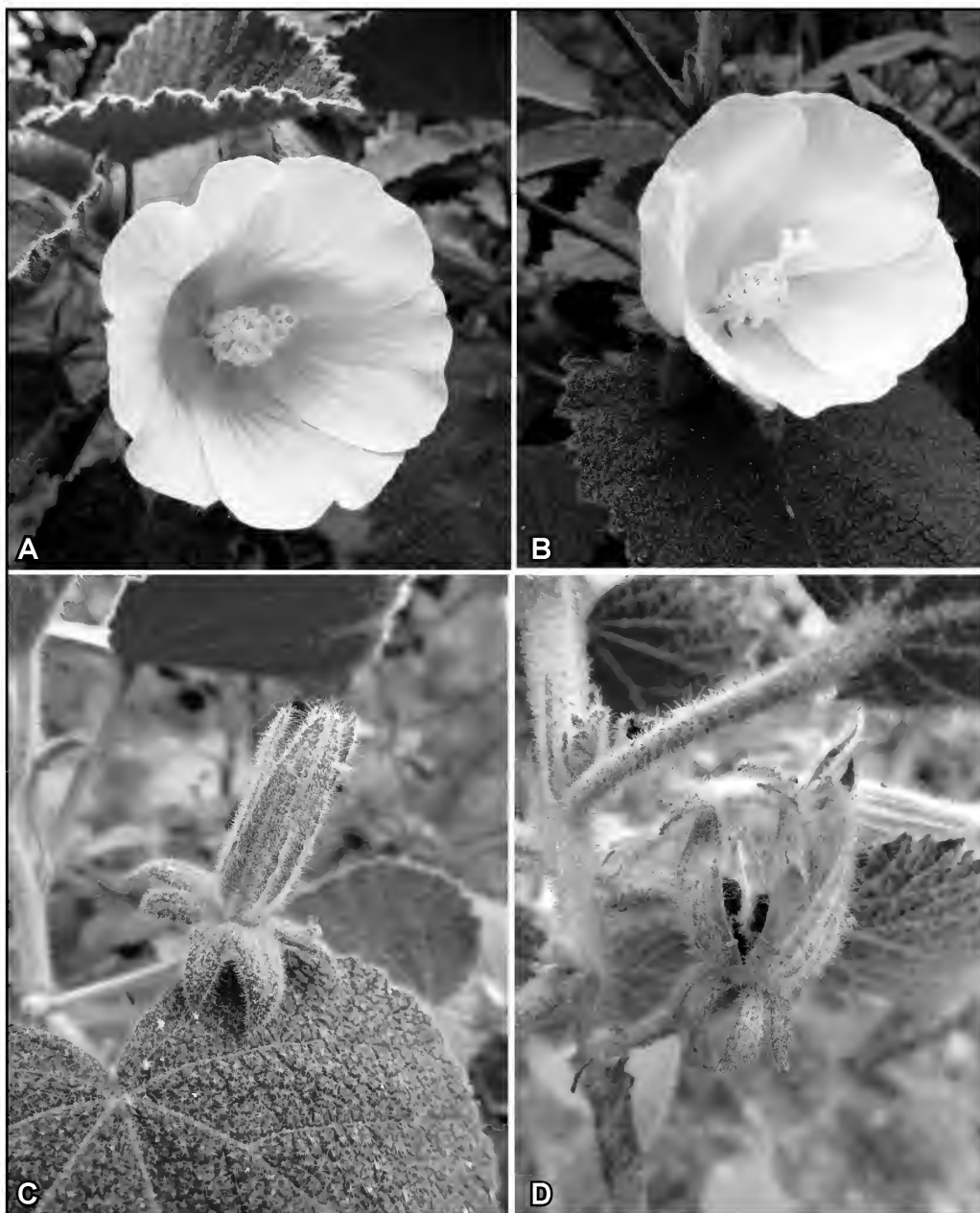


Figure 1. *Hibiscus campanulatus*. A – flowering plant *in situ* showing an axillary, pale pink flower with campanulate corolla; B – flowering plant *in situ* with a white, campanulate flower; C – flower in bud showing distinct calyx with shorter, recurved epicalyx lobes; D – fruit dehiscent with some mature black-coloured seeds. Images by A. Perkins.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 4 May 2014, S.A. Dalglish ELA 41 (PERTH); 23 May 2011, P. Hoffman BES 00472 (PERTH); 17 Aug. 2011, P.J.H. Hurter & J. Naaykens 11013 & 11014 (PERTH); 20 Apr. 2012, B. Morgan BMor 1343 (PERTH); 31 May 2014, J. Naaykens JN 14-8-J151 (PERTH); 31 May 2014, J. Naaykens JN 14-8-(H50-3) (PERTH); 17 July 2014, J. Naaykens JN 14-8-J420 (PERTH); 17 July 2014, J. Naaykens

JN 14-8-J429 (PERTH); 16 Aug. 2014, *J. Naaykens* JN 14-8-J364 (PERTH); 17 Aug. 2014, *J. Naaykens* JN 14-8-J388 (PERTH); 17 Aug. 2014, *J. Naaykens* JN 14-8-J430 (PERTH); 23 Mar. 2012, *S. Reiffer* SRe 111 (PERTH); 27 May 2015, *S. Reiffer* SRe C-020 (PERTH).

**Phenology.** Plants predominantly flowering and fruiting from March to November but may sporadically flower over the summer months in response to localised rainfall events.

**Distribution and habitat.** This species is restricted to the Hamersley subregion of the Pilbara bioregion in Western Australia (Western Australian Herbarium 1998–), where it is known from the southern central Hamersley Range near Paraburdoo (Figure 2). Plants grow within incised ironstone gullies, protected areas below cliffs, rocky creeklines and below breakaways, often with underlying loamy to skeletal ironstone soils.

**Conservation status.** *Hibiscus campanulatus* is listed by Smith (2017) as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *Hibiscus* sp. Canga (P.J.H. Hurter & J. Naaykens 11013).

**Etymology.** The epithet is Latin for bell-shaped and refers to the flowers, which have overlapping petals that are often reflexed at their tips.

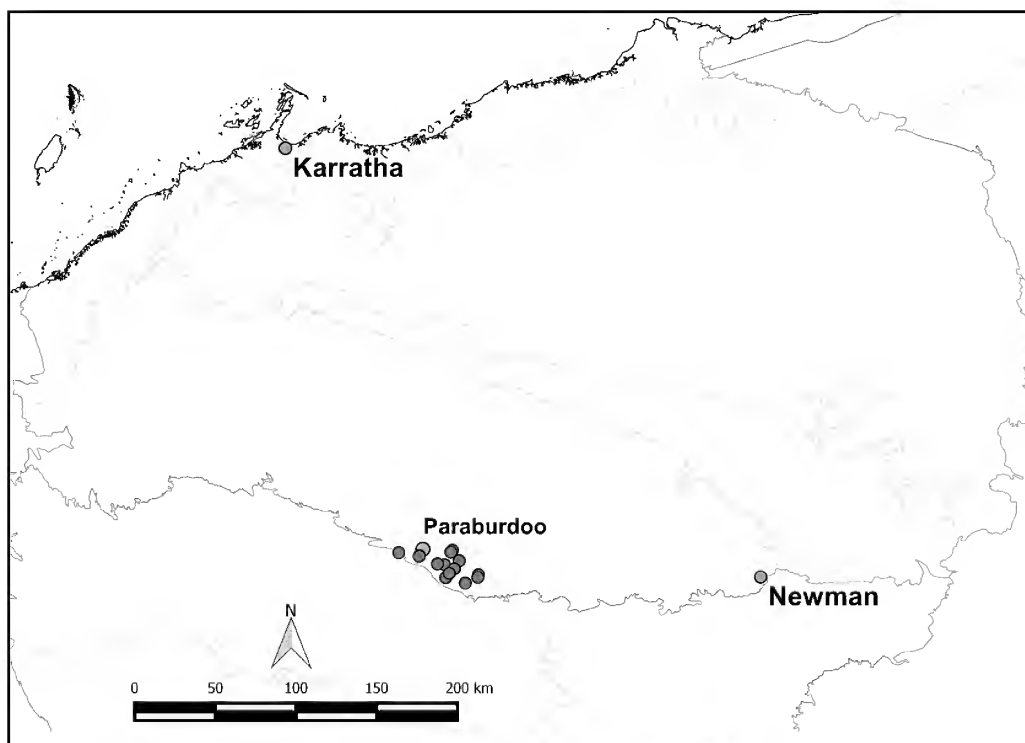


Figure 2. Distribution of *Hibiscus campanulatus* based on specimens held at PERTH (●). Map centred on the Pilbara bioregion, Western Australia, with *Interim Biogeographic Regionalisation for Australia version 7* bioregions (Department of the Environment 2013) shown in darker grey and subregions in light grey.

*Affinities.* *Hibiscus campanulatus* is most similar to *H. haynaldii* F.Muell. based on vegetative and floral morphology. Ferdinand von Mueller described *H. haynaldii* based on material collected by John Forrest from ‘the sources the Menilyalya’ (Minilya River) ‘towards Sharks-Bay’ (Mueller 1883).

*Hibiscus campanulatus* differs from *H. haynaldii* by having a much sparser indumentum on all parts of the plants. This makes the surfaces of mature leaf laminae, epicalyx lobes and calyces clearly visible through the indumentum on plants of *H. campanulatus* (whereas these surfaces are completely covered by hairs in *H. haynaldii*). This sparser indumentum in *H. campanulatus* also makes the raised nerves on the abaxial surfaces of the epicalyx lobes and calyces clearly visible (Figure 1C, D). *Hibiscus campanulatus* also differs from *H. haynaldii* by having distinctly spreading to recurved epicalyx lobes (ascending epicalyx in *H. haynaldii*), distinctly campanulate flowers (Figure 1A, B; funnel-shaped in *H. haynaldii*) and concolorous petals (petals have a dark basal spot in *H. haynaldii*).

### Acknowledgements

The author thanks Rio Tinto for supporting the Identification Botanist position at the Western Australian Herbarium, and Scott Reiffer and Jeremy Naaykens (both Rio Tinto) for comments on the manuscript. Julia Percy-Bower and Skye Coffey (both Western Australian Herbarium) are thanked for curatorial assistance, as is Johan Hurter for originally nominating this taxon for Priority conservation status in Western Australia.

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## SHORT COMMUNICATION

***Teucrium disjunctum*, a new name for *Spartothamnella canescens* (Lamiaceae)**

***Teucrium disjunctum*** K.R.Thiele & K.A.Sheph., *nom. nov.*

*Spartothamnella canescens* K.R.Thiele & K.A.Sheph., *Nuytsia* 24: 180–183 (2014). *Type*: Mount Riddock, Northern Territory, 13 September 1973, P.K. Latz 4310 (*holo*: DNAA0052527 (DNA 52527); *iso*: AD, BRI!, CANB!, NSW, PERTH 02527383!).

*Notes.* Recent molecular phylogenetic analyses of nuclear (ITS) and chloroplast (*ndhF*, *trnL* intron + *trnL-trnF* intergenic spacer) sequences indicate that *Teucrium* L. (Lamiaceae) is paraphyletic with respect to the Australian genera *Spartothamnella* Briq. and *Oncinocalyx* F.Muell. and the New Zealand monotypic *Teucrium* Hook.f. (Salmaki *et al.* 2016). Only two samples of *Spartothamnella* were included in this study: *S. teucrifolia* (F.Muell.) Moldenke (G.J. Keighery & N. Gibson 1740, PERTH 04474341) and *S. puberula* (F.Muell.) Maiden & Betche (R.W. Purdie & D.E. Boyland 116, CANB 273128.1), the latter represented only by an *ndhF* sequence from a previous study by Steane *et al.* (2004). Despite the poor level of sampling, *Spartothamnella* was shown to be nested well within the ‘*Teucrium* core clade’ (which includes the type species *T. fruticans* L.) in the *ndhF* and combined *trnL-F* + ITS trees.

Salmaki *et al.* (2016) highlighted shared synapomorphies among the four genera including: a similar pollen wall structure; radially symmetric, solitary flowers; an ovary that is lobed from a quarter to half its length; nutlets with an indumentum of hairs and glands. They also suggested that features previously thought to be diagnostic, such as fruit morphology, are highly plastic in Lamiaceae. While only a relatively small subset of the 250 species currently included in *Teucrium* were sampled for this study, the evidence suggests that it is unlikely that *Teucrium s. str.* (i.e. excluding *Spartothamnella*, *Oncinocalyx* and *Teucrium*) will be found to be monophyletic in the future.

Salmaki *et al.* (2016) provided five new combinations to include species of *Spartothamnella*, *Oncinocalyx* and *Teucrium* in *Teucrium*; however, the recently described *S. canescens* K.R.Thiele & K.A.Sheph. (Thiele & Shepherd 2014), which occurs in Western Australia and the Northern Territory, was overlooked. The epithet *canescens* is preoccupied in *Teucrium* by *T. canescens* G.Forst. (and the illegitimate *T. canescens* Holmboe) and hence a new name is required.

*Etymology.* From the Latin *disjunctus* (separate, distinct) in reference to the fact that this species is currently known from three widely disjunct regions; see the circled populations in Figure 1 of Thiele and Shepherd (2014).

**Acknowledgements**

Juliet Wege is acknowledged for bringing the recent research on *Teucrium* to our attention.

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## Taxonomic notes on *Asterolasia* (Rutaceae) in Western Australia to inform conservation

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### Abstract

Wege, J.A. Taxonomic notes on *Asterolasia* (Rutaceae) in Western Australia to inform conservation. *Nuytsia* 28: 141–146 (2017). Following examination of collections at the Western Australian Herbarium, the Threatened species *Asterolasia nivea* (Paul G. Wilson) Paul G. Wilson is synonymised under *A. grandiflora* (Hook.) Benth. A revised description is provided for *A. grandiflora*, a geographically restricted species that will remain listed as Priority Four under Department of Parks and Wildlife Conservation Codes for Western Australian Flora despite its expanded circumscription. *Asterolasia pallida* Benth. subsp. *hyalina* Paul G. Wilson, a distinctive taxon previously only known from Dryandra State Forest, is raised to species level and *A. sp.* Kalgan River (S. Barrett 1522), which is listed as Threatened in Western Australia, is treated as synonymous. While the latter action greatly expands the known range of *A. hyalina* (Paul G. Wilson) Wege, this taxon retains its conservation ranking of Priority Two. A key to species of *Asterolasia* F. Muell. in Western Australia is provided.

### Introduction

This paper serves to clarify the taxonomic status of *Asterolasia nivea* (Paul G. Wilson) Paul G. Wilson and *A. sp.* Kalgan River (S. Barrett 1522), both of which are listed as Threatened in Western Australia (Smith 2017), with the former also listed as Vulnerable under the federal *Environment Protection and Biodiversity Conservation Act 1999*. Their assessment has been made possible by the taxonomic framework provided by Wilson (2013) and the survey work, collections and observations of science and conservation personnel and volunteers.

### *Asterolasia nivea* = *A. grandiflora* (Hook.) Benth.

*Asterolasia nivea* was originally defined as distinct from *A. grandiflora* on account of its narrowly oblong to oblong leaves (*cf.* ovate to elliptic in *A. grandiflora*) and its smaller (8–10 mm long), white petals (*cf.* 10–15 mm long and pink to mauve) (Wilson 1980). Few specimens of both species were available for study at the time, with *A. nivea* thought to be restricted to near Bindoon and *A. grandiflora* to the York–Toodyay area. Subsequent collections reflect a more continuous distribution, with Wilson (2013) noting that the two species grade into each other.

Recent examination of an expanded pool of specimens at the Western Australian Herbarium ( $n = 69$ ) and associated images reveals that leaf shape, and petal size and colour are more variable in *A. grandiflora*

and *A. nivea* than previously documented. For example, there are pink-flowered specimens with petals as short as 6–8 mm (e.g. *R. Davis* 4280, *F. Hort* 1158, *F. Hort* 2029, *H. Seeds* 152), white-flowered specimens with petals as long as 12–13 mm (e.g. *F. Hort* 2005, *L. Talbot s.n.* PERTH 01449125) and collections with variably-sized petals (e.g. 6–13 mm long, *F. Hort* 1158). Plants from populations in Wandoo National Park (Figure 1) and nature reserves near Toodyay and Clackline have been recorded as having either pink or white flowers (*R.J. Cranfield & J.L. Robson* RJC 7828 & 7829; *J. & F. Hort s.n.* PERTH 04958071, Figure 1) or both pink and white flowers (*R.J. Cranfield & J.L. Robson* RJC 7826 & 7827). Leaf size and shape is highly variable between and sometimes within populations. Other differences between Wilson's (2013) descriptions of *A. nivea* and *A. grandiflora*, such as petal shape (elliptic vs ovate) and stamen number (15–20 vs 12–15), are similarly taxonomically uninformative.

*Asterolasia nivea* is therefore best synonymised under *A. grandiflora*, forming a single, geographically restricted species with a petal hair morphology that is highly distinctive in the genus.

***Asterolasia grandiflora*** (Hook.) Benth., *Fl. Austral.* 1: 352–353 (1863); *Phebalium grandiflorum* Hook., *Icon. Pl.* 8: t. 724 (1848); *Eriostemon grandiflorus* (Hook.) F. Muell., *Fragm.* 1(5): 105 (1859); *Urocarpus grandiflorus* (Hook.) Paul G. Wilson, *Nuytsia* 1: 207 (1971). *Type*: [Western Australia], *J. Drummond* 12 (*holotype*: K 000717293 image!).

*Asterolasia nivea* (Paul G. Wilson) Paul G. Wilson, *Nuytsia* 6(1): 8 (1987), *syn. nov.*; *Urocarpus nivea* Paul G. Wilson, *Nuytsia* 3(2): 211–213 (1980). *Type*: north of Bindoon, Western Australia [precise locality withheld for conservation reasons], 19 September 1979, *P.G. Wilson* 11704 (*holotype*: PERTH 00998621!; *isotypes*: CANB 297654 image!, K 000717290 image!, MEL 0584109 image!, NSW 778396 image!).

Erect or spreading, open *shrub* or *subshrub* c. 15–60(–80) cm high. *Leaves* shortly petiolate, oblong, elliptic or ovate (sometimes narrowly so), 4–20 mm × 1.5–6(–9) mm, moderately stellate-hairy adaxially when young becoming scabridulous when mature, densely to moderately stellate-hairy abaxially; margins sometimes recurved. *Umbels* terminal or axillary, sessile, 3- or 4-flowered; pedicels 5–17 mm long, with dark yellow or rufous, thick-centred stellate hairs. *Sepals* semicircular to broadly deltate, 0.2–0.3 mm long, glabrous. *Petals* elliptic or ovate, acute, 6–15 × 2.8–9 mm, pale to deep pink or white; abaxial surface closely covered with yellow, thick-centred stellate hairs that form an armour-like cover to the bud, colourless stellate hairs with branches radiating in all directions present near the margins. *Stamens* c. 12–24, glabrous; anthers 1–1.4 mm long, terminal gland not apparent. *Carpels* 2–4, stellate-hairy; style glabrous; stigma lobes fleshy, slightly recurved. *Cocci* with a beak c. 2.5–3 mm long. (Figure 1)

**Diagnostic features.** *Asterolasia grandiflora* can be distinguished from all other members of the genus by the following combination of characters: yellow, thick-centred stellate hairs on the abaxial surface of the petals that form an armour-like cover to the bud; and two to four carpels.

**Selected specimens.** WESTERN AUSTRALIA: [localities withheld for conservation reasons] 30 Aug. 1990, *R.J. Cranfield & J.L. Robson* RJC 7826 & 7827 (PERTH); 31 Aug. 1990, *R.J. Cranfield & J.L. Robson* RJC 7828 & 7829 (PERTH); 16 Oct. 2012, *A.D. Crawford* ADC 2215 (PERTH); 8 Oct. 1997, *R. Davis* 4280 (PERTH); 8 Sep. 1997, *J. & F. Hort s.n.* (PERTH); 21 Sep. 2000, *F. Hort* 1158 (PERTH); 22 Sep. 2003, *F. Hort* 2005 (PERTH); 6 Sep. 2003, *F. Hort* 2029 (PERTH); 11 Aug. 1984, *G.J. Keighery* 7256 (PERTH); 2 Sep. 1997, *J.L. Robson s.n.* (PERTH 04958039); 2 Sep. 1997, *J.L. Robson s.n.* (PERTH 04958047); 26 July 1903, *O.H. Sargent* 17 (PERTH); 23 Sep. 2000, *H. Seeds* 152 (PERTH); 4 Sep. 1990, *L. Talbot s.n.* (PERTH).

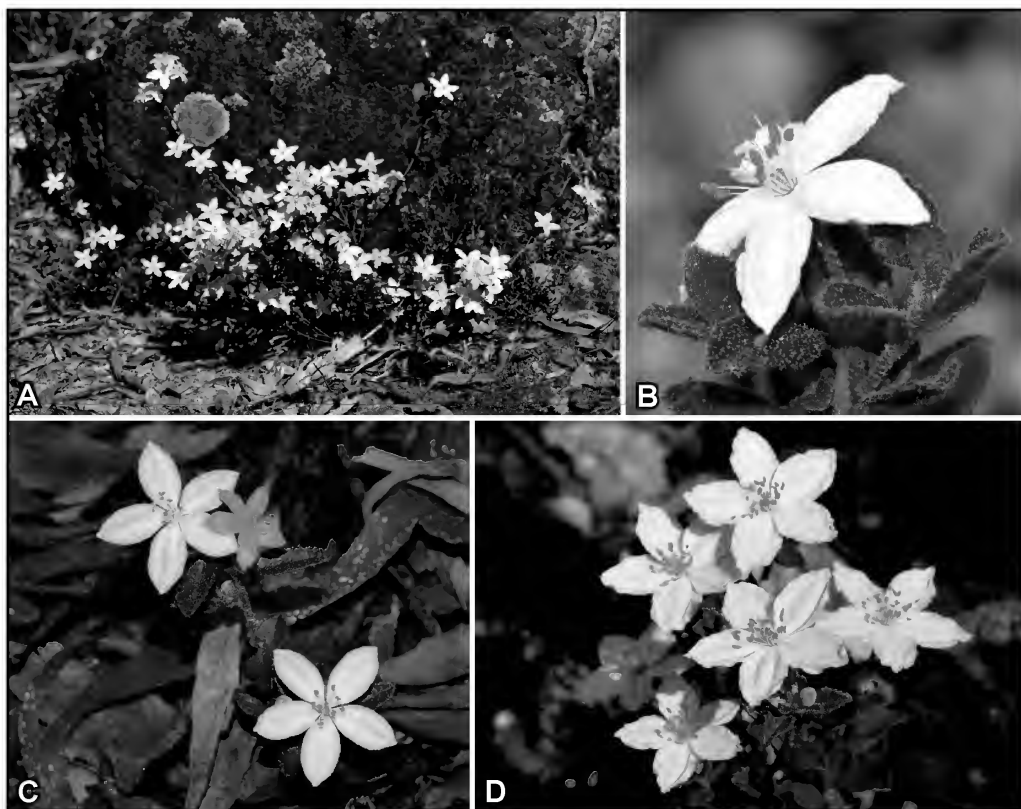


Figure 1. Petal colour and size variation within a single population of *Asterolasia grandiflora* from Wandoo National Park (J. & F. Hort s.n. PERTH 04958071). Images © Fred and Jean Hort.

*Phenology.* Flowers from July to October.

*Distribution and habitat.* *Asterolasia grandiflora* is confined to the northern portion of the Northern Jarrah Forest subregion and adjacent Avon Wheatbelt bioregion, occurring in the general vicinity of Bindoon, Toodyay and York (Figure 2). It grows in lateritic soils on hillslopes and breakaways, most commonly in *Eucalyptus accedens* or *E. wandoo* woodland.

*Conservation status.* *Asterolasia grandiflora* is currently listed as Priority Four under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (Smith 2017). The inclusion of populations previously referred to *A. nivea* expands the known range of the species and increases the number of populations that occur in nature reserves; however, it is still geographically restricted and rare, with some populations appearing to be in decline (F. & J. Hort pers. comm.). As such, its conservation status is undergoing review (M. Smith pers. comm.).

***Asterolasia* sp. Kalgan River (S. Barrett 1522) = *A. hyalina* (Paul G.Wilson) Wege**

*Asterolasia* sp. Kalgan River is known from a single population on private property north-east of Albany. It was added to Western Australia's vascular plant census in 2006 and, following extensive regional surveys of potentially suitable habitat, was listed as Threatened with a status of Vulnerable (Smith 2017). This taxon was not discussed by Wilson (2013).

Examination of collections of *Asterolasia* at the Western Australian Herbarium has ascertained that *A. sp.* Kalgan River is morphologically comparable to *A. pallida* Benth. subsp. *hyalina* Paul G. Wilson, a conservation-listed taxon hitherto recorded from Dryandra State Forest, some 225 km to the north-north-west. Collections from both Albany and Dryandra have small leaves (3–7(–16) mm long), glabrous sepals, colourless stellate hairs with mostly appressed branches on the abaxial surface of the petals, and ten stamens. The material from the Albany population differs from the Dryandra population in having pale mauve-pink petals with a white centre (*cf.* pure white) and its leaves are more commonly deltate (i.e. with a truncate base) than ovate (*cf.* ovate). This variation is not considered herein to be taxonomically significant and *A. sp.* Kalgan River is synonymised below, with *A. pallida* subsp. *hyalina* treated as a distinct species (see notes provided below).

***Asterolasia hyalina*** (Paul G. Wilson) Wege, *comb. et stat. nov.*

*Asterolasia pallida* Benth. subsp. *hyalina* Paul G. Wilson, *Nuytsia* 12(1): 84 (1998). *Type*: Dryandra [State Forest], Western Australia, 5 September 1992, G.J. Keighery 12276 (*holotype*: PERTH 03341410!).

*Asterolasia sp.* Kalgan River (S. Barrett 1522), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 16 February 2017], *syn. nov.*

Erect or spreading and somewhat straggly *shrub* or *subshrub* *c.* 30–70 cm high. *Leaves* shortly petiolate, ovate to deltate (sometimes narrowly so), 3–7(–16) mm × (1.2–)2–4(–6.5) mm, sparsely to moderately stellate-hairy on both surfaces, becoming glabrous or somewhat scabridulous with age; margins sometimes recurved. *Umbels* terminal or axillary, sessile, (2–)3–8-flowered; pedicels 8–20 mm long, bearing rufous and colourless stellate hairs with branches radiating in all directions. *Sepals* broadly deltate, 0.2–0.3 mm long, glabrous. *Petals* elliptic to narrowly ovate, acute, 3–7 × 1.5–4.5 mm, white or mauve-pink grading white toward the centre, abaxial surface bearing colourless stellate hairs with mostly appressed branches. *Stamens* 10, glabrous; anthers 1–1.3 mm long, terminal gland not apparent. *Carpels* (1)2, stellate-hairy; style glabrous; stigma lobes fleshy, slightly recurved. *Cocci* with a beak *c.* 2.5–3.2 mm long.

*Diagnostic features.* *Asterolasia hyalina* can be differentiated from all other species in the genus by the following combination of characters: ovate to deltate leaves that are 3–7(–16) mm long; petals with colourless, appressed stellate hairs; and one or two carpels.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 30 Aug. 2006, S. Barrett 1522 (MEL, PERTH); 30 Oct. 2006, J.A. Cochrane JAC 6086 (PERTH); 5 Oct. 2002, J. Foss & P. Gurry 205 (PERTH); 5 Sep. 1992, G.J. Keighery 12284 (PERTH); 26 Aug. 1987, D.M. Rose 166 (PERTH).

*Phenology.* Flowers from August to September.

*Distribution and habitat.* *Asterolasia hyalina* is known from four populations, three of which occur in Dryandra State Forest at the boundary of the Avon Wheatbelt bioregion and Northern Jarrah Forest subregion; the fourth, southernmost population is from private property located north-east of Albany at the south-eastern end of the Southern Jarrah Forest subregion (Figure 2). The northernmost populations grow in sandy loam over granite or laterite on hillslopes or along creeklines in *Eucalyptus wandoo*, *E. accedens* or *E. astringens* woodland, sometimes in association with *Allocasuarina huegeliana*. The population near Albany grows in red clay loam over granite on a slope above the Kalgan River primarily

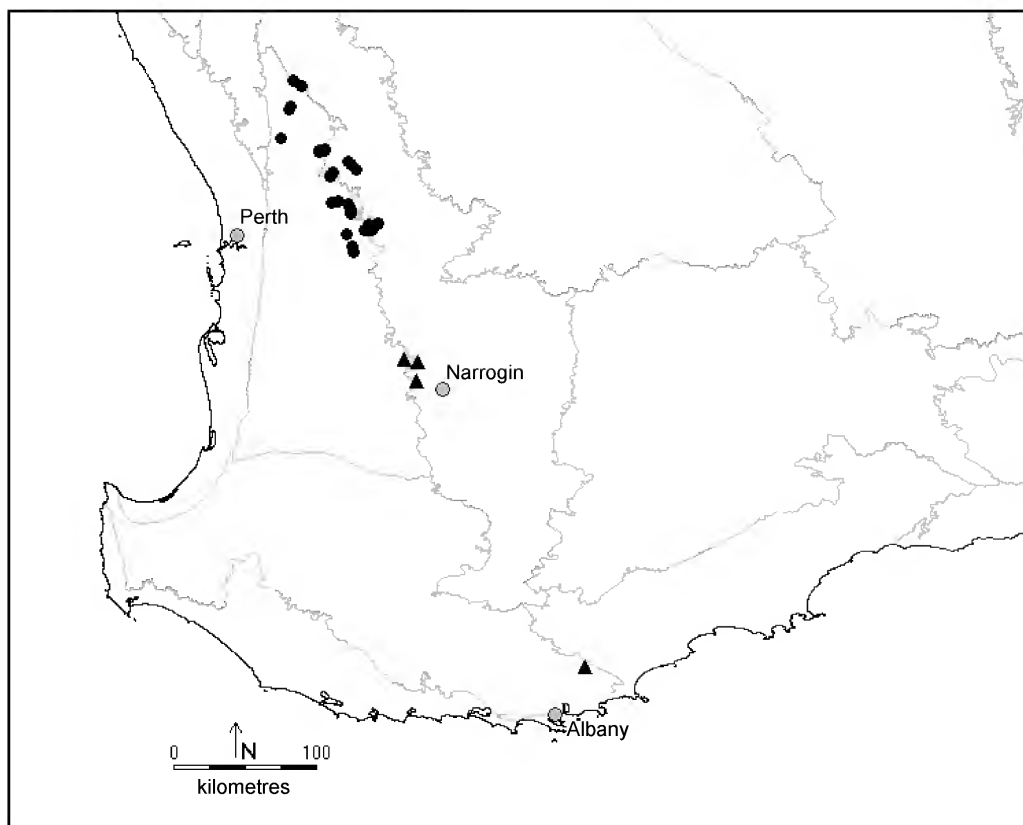


Figure 2. Distribution of *Asterolasia grandiflora* (●) and *A. hyalina* (▲) in Western Australia, with IBRA ver. 7 bioregions and subregions (Department of the Environment 2013) indicated in pale grey.

in scrub-heath with species including *Calothamnus quadrifidus*, *Hypocalymma angustifolia*, *Acacia sulcata* subsp. *sulcata*, *Hakea lissocarpa*, *Daviesia horrida*, *Leucopogon revolutus*, *Prostanthera canaliculata* and *Xanthorrhoea platyphylla*.

**Conservation status.** *Asterolasia hyalina* is listed as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *A. pallida* subsp. *hyalina* (Smith 2017). While the inclusion of the population near Albany under this species greatly expands its extent of occurrence, it remains data deficient, with both population centres highly significant from a conservation perspective. The species is in need of further survey, including areas of suitable habitat between the two population centres, to ascertain whether a Threatened Flora listing is warranted.

**Notes.** *Asterolasia hyalina* is best regarded as a distinct species since it is quite dissimilar to *A. pallida*, a species with a reasonably widespread distribution in the Jarrah Forest bioregion. Differences between the two species include the size and shape of the leaves (ovate to deltate and 3–7(–16) mm long in *A. hyalina* cf. elliptic to broadly elliptic and (6–)10–30(–40) mm long in *A. pallida*), stamen number (10 in *A. hyalina* cf. 15–32), sepal surface (glabrous in *A. hyalina* cf. stellate-hairy), and colour and morphology of the stellate hairs on the petals (colourless with mostly appressed branches in *A. hyalina* cf. rufous and colourless with branches radiating in all directions). Wilson's (2013) description of *A. pallida*, which does not encompass the variation exhibited by *A. pallida* subsp. *hyalina*, remains

informative despite its change in circumscription, although the following modifications are proposed: *leaves* (6–)10–30(–40) mm long; *sepals* stellate-hairy; *stamens* c. 15–32. *Asterolasia dielsii* C.A. Gardner remains a synonym of *A. pallida*.

*Asterolasia hyalina* appears to be closely allied to *A. drummondii* Paul G. Wilson, a rare species with a distribution centred on the Lesueur Sandplain subregion. Both species have umbels with numerous flowers, petal hairs with appressed branches and ten stamens; however, unlike *A. hyalina*, *A. drummondii* has petals with mostly rufous-coloured stellate hairs, and elliptic to oblong (rarely ovate or lanceolate) leaves (6–)10–30 mm long.

### Key to species of *Asterolasia* in Western Australia (adapted from Wilson 2013)

1. Petals yellow, with hairs of flat, fimbriate scales ..... **A. squamuligera**
- 1: Petals white, pink or mauve, with stellate hairs not as above
  2. Petal hairs mostly yellow with prominently thickened centres and short, erect to somewhat spreading branches, forming an armour-like cover to the bud ..... **A. grandiflora**
  - 2: Petal hairs not as above, with branches radiating in all directions or appressed
    3. Petal hairs with branches radiating in all directions; stamens c. 15–32 ..... **A. pallida**
    - 3: Petal hairs appressed; stamens 10
      4. Petals hairs colourless; leaves ovate or deltate, 3–7(–16) mm long ..... **A. hyalina**
      - 4: Petals with both rufous and colourless hairs; leaves elliptic to oblong (rarely ovate or lanceolate), (6–)10–30 mm long ..... **A. drummondii**

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***Acacia nicholsonensis* (Fabaceae), a new ‘Minni Ritchi’-barked species  
of *Acacia* sect. *Juliflorae* from the Gulf of Carpentaria region of  
Northern Australia**

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**Abstract**

Cuff, N.J. & Cowie, I.D. *Acacia nicholsonensis* (Fabaceae), a new ‘Minni Ritchi’-barked species of *Acacia* sect. *Juliflorae* from the Gulf of Carpentaria region of Northern Australia. *Nuytsia* 28: 147–158 (2017). *Acacia nicholsonensis* Cuff is described as a new species of *Acacia* Mill. sect. *Juliflorae* (Benth.) Maiden & Betche. *Acacia nicholsonensis* is currently only known from the upper Nicholson River catchment in the far east of the Northern Territory where it is restricted to the levees and banks of major river channels. A key to the ‘Minni Ritchi’-barked *Acacia* species of the Top End of the Northern Territory and adjacent regions of tropical northern Australia is presented. The conservation status and ecology of the new species are discussed.

**Introduction**

Patterns of diversity and endemism in the Northern Territory flora have been previously documented (Woinarski *et al.* 2006) with topographically and geologically diverse landscapes recognised as particular areas of significance. These patterns hold for Australia’s largest vascular plant genus, *Acacia* Mill., with previous studies highlighting both the Arnhem Plateau and more broadly the rocky uplands of the Kimberley to Mt Isa tablelands as phytogeographically important for *Acacia* sections *Lycopodiifoliae* Pedley and *Juliflorae* (Benth.) Maiden & Betche (Hnatiuk & Maslin 1988; González-Orozco *et al.* 2011; Maslin & Cowie 2014). Indeed, northern Australia more generally is recognised as a centre of richness and diversity for sect. *Juliflorae* (Hnatiuk & Maslin 1988).

In this paper we describe a new species with distinctive ‘Minni Ritchi’ bark from the Gulf Fall and Uplands bioregion (Department of Environment 2013) in *Acacia* sect. *Juliflorae*, the largest section of the genus represented in the Northern Territory. ‘Minni Ritchi’ is a distinctive bark type usually found within, but not restricted to the genus *Acacia*, characterised by a pattern of exfoliation in which the outermost layers peel from the trunk in short, narrow strips, often from both ends, back upon themselves creating an appearance similar to planed timber (Brooker & Kleinig 1990; Maslin 1991, 2001).

The new species was first collected in 2010 in the far east of the Northern Territory in the upper reaches of the Nicholson River catchment, a diverse but relatively poorly surveyed area. The complex regional lithology and topographic diversity of the area have resulted in a varied range of landforms, which when superimposed with contemporary ecological processes (e.g. fire regimes) produces a complex mosaic

of habitat types operating at various spatial and temporal scales. This is a characteristic shared with other known areas of *Acacia* richness and diversity (Maslin *et al.* 2013). Intensive botanical survey has not been conducted within the area where the species was encountered since the 1970s, and the first collections of the new species were purely incidental to other survey work. This lack of systematic survey effort and the diversity of habitats suggest that there is reasonable likelihood further new taxa may be discovered in the region or the currently known geographic range of *A. nicholsonensis* Cuff will be extended. Indeed, recent publication of *A. citriodora* Kodela & Maslin includes new records of the species from the upper section of the South Nicholson River catchment (Kodela & Maslin 2015).

In this paper we provide a diagnostic key to other ‘Minni Ritchi’-barked species known to occur within the Top End of the Northern Territory (north of 19° S; NT) and in adjoining regions of tropical Western Australia (WA) and Queensland (Qld).

### Methods

This study was based primarily on morphological examination of field collections made by the first author as part of fire ecology projects in the Waanyi/Garawa Aboriginal Land Trust (ALT) between September 2010 and September 2011. Subsequent to its initial field collection in 2010, further opportunistic collection of specimens, and preliminary survey of the area to establish the distribution and abundance of the taxon, was undertaken in 2011 through to September 2015. Morphometric measurements were obtained from both fresh and dried materials now housed at DNA, MEL, NSW and PERTH.

#### Key to ‘Minni Ritchi’-barked species of *Acacia* in tropical northern Australia

1. Phyllodes narrowly elliptic to orbicular or oblanceolate to obovate, 10–32 mm long, 5–15 mm wide; L:W ratio not exceeding 3; phyllode anastomoses numerous (widespread in WA, NT & western Qld)..... **A. monticola**
- 1: Phyllodes not with above combination of characters; L:W ratio usually >>5; anastomoses generally absent to few (except in *A. helicophylla*)
  2. Phyllodes distinctly spirally twisted (Top End of NT) ..... **A. helicophylla**
  - 2: Phyllodes not spirally twisted
    3. Phyllodes glabrous; seeds longitudinal (Kimberley region, WA) ..... **A. cyclocarpa**
    - 3: Phyllodes variously puberulous to hairy, the hairs often restricted to between nerves or margins, or both (rarely glabrous in *A. lysiphloia*, if so then seeds always oblique); seeds longitudinal or oblique
      4. Pod sericeous, villous or variously hairy especially when young
        5. Pods distinctly curved to openly coiled (WA) ..... **A. trachycarpa**
        - 5: Pods straight to slightly curved but never coiled
          6. Pods +/- straight-sided with a dense, persistent, golden-brown, lanate indumentum; mature phyllodes generally >90 mm long (Gulf of Carpentaria, NT & possibly Qld) ..... **A. nicholsonensis**
          - 6: Pod strongly sub-moniliform and villous, but lacking golden-brown, lanate indumentum; mature phyllodes shorter, <90 mm long (Kimberley region WA) ..... **A. minniritchi**
  - 4: Pod glabrous
    7. Pods resinous or viscid

- 8. Seeds oblique; pods straight to strongly curved (widespread) ..... **A. lysiphloia**
- 8: Seeds longitudinal; pods strongly curved into an open coil  
(Kimberley region, WA) ..... **A. cyclocarpa**
- 7: Pods not resinous or viscid
- 9. Seeds oblique (NT & Qld) ..... **A. chisholmii**
- 9: Seeds longitudinal (WA) ..... **A. delibrata**

### Taxonomy

***Acacia nicholsonensis* Cuff, *sp. nov.***

*Type:* South Nicholson River crossing, Waanyi/Garawa Aboriginal Land Trust, Northern Territory, 29 September 2010, N.J. Cuff 019 & D. Lynch (*holo:* DNA D0221290; *iso:* PERTH 08595003).

*Acacia* sp. Nicholson River (N. Cuff & D. Lynch NT019-NC) Northern Territory Herbarium, in *Australia's Virtual Herbarium* <http://avh.chah.org.au/> [accessed 5 July 2016] and *Flora NT* <http://eflora.nt.gov.au/> [accessed 5 July 2016].

Obconic shrub or small tree 3–6 m tall, stems and major branches straight to crooked, ascending, with smaller lateral branches obliquely ascending to erect; crowns of mature trees rounded with sub-dense, grey-green foliage. *Bark* ‘Minni Ritchi’, red to red-brown, shedding in small strips to c. 40 mm in length and curling from both ends (particularly on younger branches), in multiple layers on trunk and major branches, becoming thinner on smaller branches. *Branchlets* red to red-brown with appressed white hairs when bark intact, becoming mottled with patchy red-brown bark shedding over smooth, yellow to light reddish brown bark when older, appearing somewhat fissured as bark splits, obscurely yellow-ribbed in distal portions but not obviously resinous. *New shoots* yellow-brown, angled or ribbed, with short, straight, white hairs 0.2–0.5 mm long. *Stipules* triangular to lanceolate, persistent, 0.8–2 mm long, thin-textured, brown with scattered, pale, straight hairs. *Youngest phyllodes* dull green to grey-green, compressed, narrowly transversely elliptic to sub-terete or flat in TS, generally not resinous, occasionally with sparse, brown-yellow resin encrusting nerves, pubescent, with short, straight, pale to golden hairs on and between raised, yellowish nerves. *Mature phyllodes* scattered, (85–)100–150(–185) mm long, 1.1–1.5 mm wide, flat, narrowly-linear to linear, straight to shallowly incurved or rarely shallowly sigmoid, ascending to erect, not rigid, singular at nodes, pale green to grey-green, with sparse to dense, short, appressed hairs between nerves and longer, isolated, ascending hairs on nerves and margins; *longitudinal nerves* (3–)5–8(–10), conspicuous, parallel, sub-distant, 0.08–0.12 mm apart, of generally uniform prominence but sometimes with 1 or 2 more prominent than the others, especially on younger phyllodes; anastomoses absent; sometimes resinous on young phyllodes but resin generally absent on mature phyllodes; *margins* not resinous (except in young phyllodes), with one edge consistently slightly thickened in comparison to the other; *apices* not pungently pointed but with a short, bent or slightly hooked, stiff (innocuous) apical point; *gland* inconspicuous, pore-like, situated on abaxial margin 0.5–3 mm above pulvinus. *Inflorescences* simple, singular within phyllode axils. *Peduncles* 3–9 mm long, with dense, appressed, yellow-gold hairs. *Basal peduncular bracts* single, caducous, 1–1.5 mm long, triangular with acute apex. *Spikes* cylindrical, 15–25 mm long, 2.5–5 mm wide when dry, golden. *Bracteoles* narrowly lanceolate, exserted in buds, generally persistent or tardily deciduous after anthesis, 1.2–1.8 mm long, 0.2–0.35 mm wide, golden brown with golden, straight to slightly curved hairs on margins and abaxial surface, becoming denser toward the base. *Flowers* 5-merous. *Calyx* 0.8–1 mm long, fused for approximately 2/3–3/4 of length, lobes prominently 5-nerved, the

lobes obtuse-triangular and fringed with +/- straight hairs. *Corolla* c. 1.4–1.7 mm long, dissected for less than 1/2 length, glabrous, golden yellow. *Ovary* shortly appressed-hairy throughout. *Stamens* numerous, at least double the number of calyx/corolla lobes. *Pods* 40–110 mm long, 2.4–4 mm wide, flat, straight to moderately curved or occasionally sigmoid, linear to narrowly oblong in outline, straight-sided to slightly constricted between the seeds, not prominently raised or inflated above seeds, coriaceous to sub-woody when mature, nerveless or nerves obscured by the indumentum, bright green when young, turning light brown, viscid (especially when young), indumentum dense, lanate, of golden brown hairs 0.8–1.1 mm in length on all surfaces, except consistently shorter (<0.5 mm) on the prominently thickened, non-resin encrusted, yellowish margins of the pod. *Seeds* longitudinal in pod, 3–4.5 mm long, ovoid to ellipsoid, shiny black to dark brown; *pleurogram* prominent, 0.1–0.17 mm wide, continuous, yellowish brown; *areole* oblong, raised, c. 0.7 mm long, 0.3 mm wide and similar in colour to rest of seed. *Aril* conspicuous, approximately 2/5 length of seed, sinuously ‘folded’ below seed, pale yellow to cream. (Figures 1, 2)

*Diagnostic features.* Multi- or single-stemmed *shrub* or small *tree* with ‘Minni Ritchi’ bark. *Mature phyllodes* scattered, ascending to erect, normally flat, mostly straight to shallowly incurved, linear to narrowly linear, (85–)100–150(–185) mm long, 1.1–1.5 mm wide, non-resinous, with short, appressed hairs between nerves and longer, ascending hairs on nerves and margins, narrowly transversely elliptic in TS, dull green, with apices terminated by a short, hard, innocuous point; *longitudinal nerves* conspicuous, usually 5–8. *Peduncles* appressed-hairy. *Sepal* lamina lobes fused for 2/3–3/4 of length, with a fringe of hairs. *Pods* linear, 2.4–4.4 mm wide, straight to moderately curved and resinous with dense, lanate indumentum of golden-brown hairs. *Seeds* longitudinal, 3–4.5 mm long, dark brown to black with yellowish brown pleurogram encircling raised areole, and a prominent, cream to yellowish aril.

*Other specimens examined* (in chronological order of collection). NORTHERN TERRITORY: Waanyi/Garawa Aboriginal Land Trust, South Nicholson River crossing, 8 Aug. 2012, *N.J. Cuff s.n. & D. Lynch* (MEL, NSW, PERTH); Waanyi/Garawa Aboriginal Land Trust, South Nicholson River crossing, 9 Aug. 2012, *N.J. Cuff s.n.* (DNA); Waanyi/Garawa Aboriginal Land Trust, South Nicholson River crossing, 14 Sep. 2014, *C.P. Yates s.n. & J.D. Evans* (DNA); Waanyi/Garawa Aboriginal Land Trust, c. 3 km upstream of the South Nicholson River crossing, 23 Sep. 2015, *N.J. Cuff* 318 (DNA); Waanyi/Garawa Aboriginal Land Trust, c. 5.3 km upstream of the South Nicholson River crossing, 23 Sep. 2015, *N.J. Cuff* 325 (DNA); Nicholson River Crossing on Nicholson River Road from Benmarra Station, 24 June 2016, *K. Brennan* 10639 (DNA); Darwin Botanic Gardens Nursery, Salonika Street, *B. Wirf* 1167 (DNA); Darwin Botanic Gardens, Salonika Street, *15-B000088* (cultivated from 14 Sep. 2014, *C.P. Yates s.n. & J.D. Evans*).

*Phenology.* The duration of flowering is uncertain but appears to encompass the mid- to late dry season (June–September) and overlap with fruiting. Specimens collected in September across a number of years have had both mature fruit and flowers on the same individual. Flowers at anthesis have also been collected in early August.

There are some indications flowering and fruiting may be related to the quality of the preceding wet season. Field survey in September 2015, following a below average wet season in the Gulf of Carpentaria (Bureau of Meteorology 2015), indicated that unlike previous years, little flowering had occurred and no fruit were evident on plants in the population.

*Distribution and habitat.* Known only from the Waanyi/Garawa ALT and the adjacent Benmarra Station in the Gulf Fall and Uplands Bioregion, where it occurs on the lower levees and banks of the

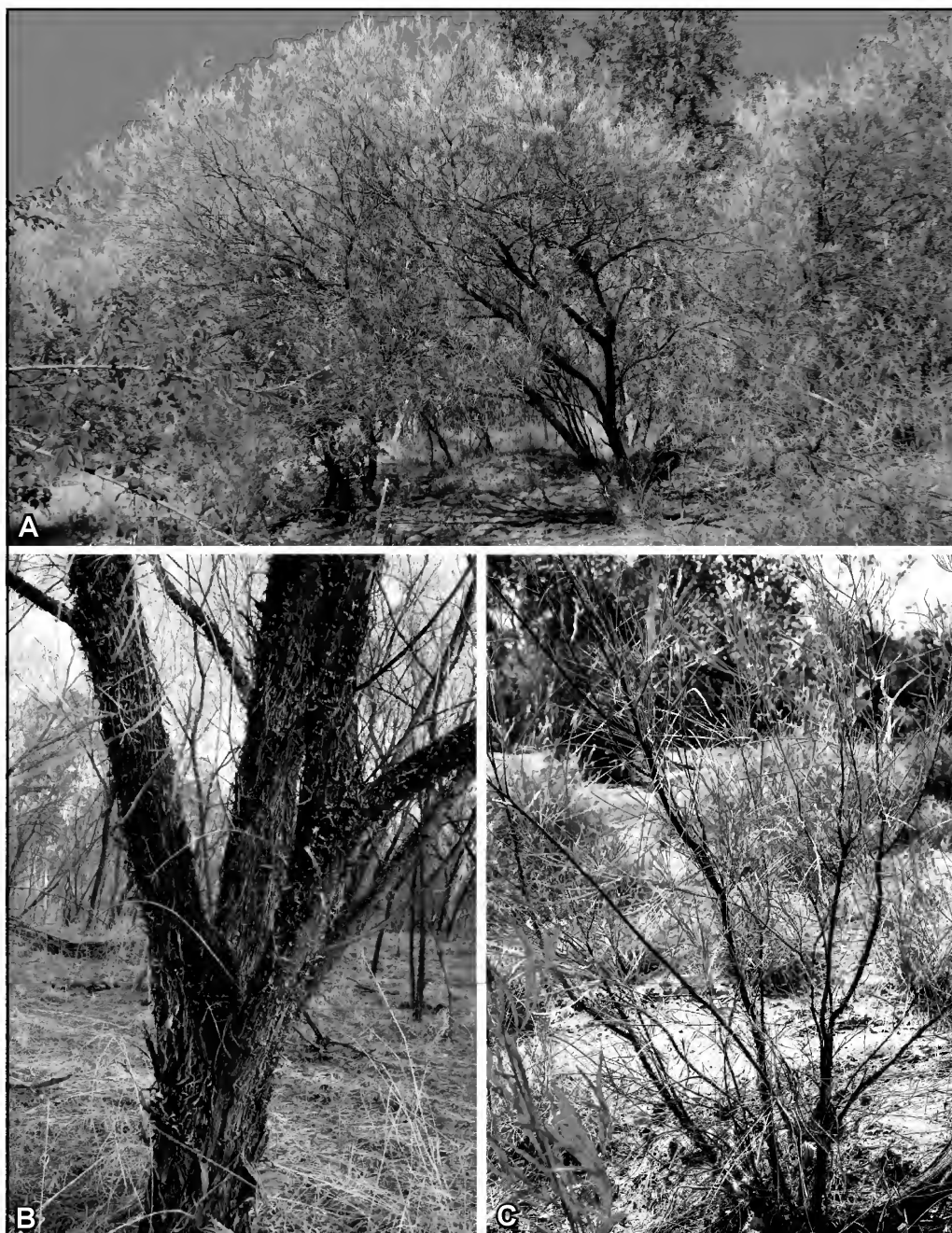


Figure 1. *Acacia nicholsonensis*. A – mature habit; B – trunk showing typical ‘Minni Ritchi’ bark; C – weakly resprouting individual. Photographs by K. van Wezel (A), N. Cuff (B) and G. Goldbergs (C).

upper reaches of the South Nicholson River (Figure 3). Field investigation suggests that the known global population (currently considered one sub-population) comprises a number of distinct patches along an approximately 7 km stretch of the South Nicholson River, where it appears to be restricted to finer red-brown loamy sands adjacent to the coarser river bed-load, and is the dominant mid-layer woody species.

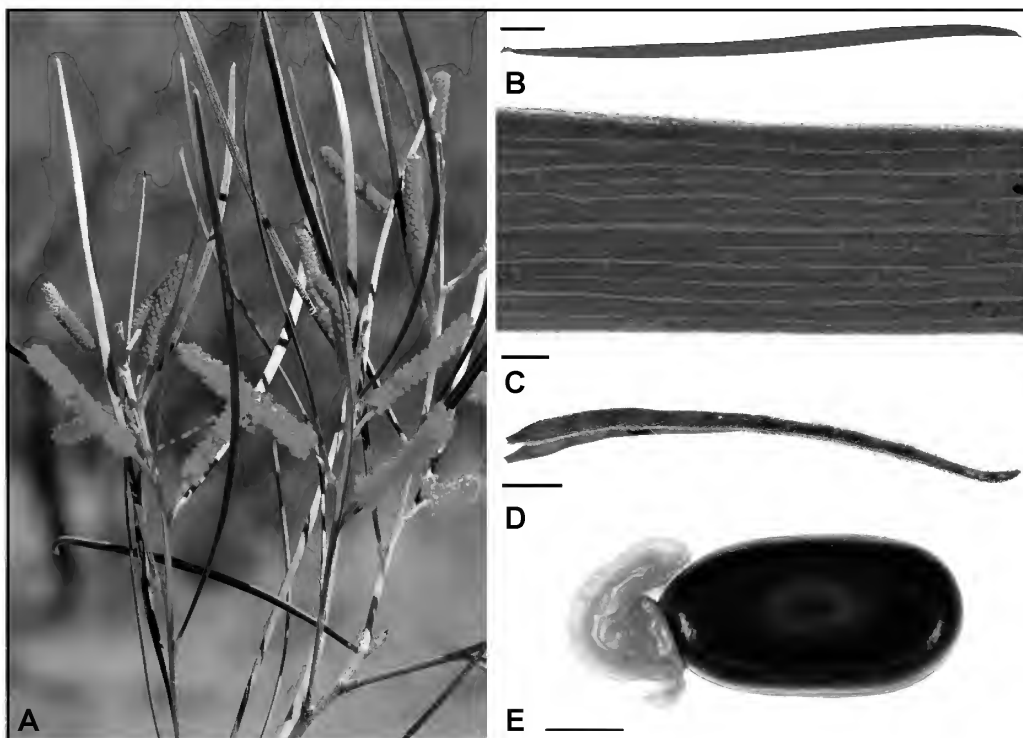


Figure 2. *Acacia nicholsonensis*. A – flowering branchlet; B – phyllode; C – phyllode detail; D – fruit; E – seed detail. Scale bars = 1 cm (B, D); 0.5 mm (C, E). Images from Brennan 10639 (A–C) and N.J. Cuff 318 (D, E). Photographs by K. Brennan.

*Acacia nicholsonensis* forms monotypic stands in association with *Eucalyptus camaldulensis* subsp. *obtusata* and *A. plectocarpa* subsp. *tamumbirinensis* in frontage open woodland. In unburnt areas the ground stratum is largely absent with sparse *Triodia pungens* hummocks prominent in more recently burnt parts of the population.

The geology of the area (known as the ‘China Wall’) is complex, with the river draining a range of igneous, variously metamorphosed sedimentary and deeply weathered Tertiary lithologies including the Buklara Sandstone, Nicholson Granite and Murphy Metamorphics (Roberts *et al.* 1972). Field survey of an approximately 10 km stretch of the river corridor around the type locality revealed a number of patches upstream of the South Nicholson River crossing, with the soil and regolith appearing to show a strong influence from the immediately adjacent Nicholson Granites. Conversely, the species was largely absent from accessible downstream sections of the riparian corridor as the soils transitioned into the heavier-textured loams derived from the Murphy Metamorphics and finer-grained sedimentary rocks of the Mullera Formation.

Survey of smaller alluvial systems draining the China Wall to the east of the type locality has so far failed to locate additional sub-populations of *A. nicholsonensis* in similar habitats. Further survey in the area is considered moderately likely to locate additional sub-populations upstream of the type locality. However, survey indicates that despite apparently suitable habitat being present downstream, the species is absent. Extensive surveys in North West Queensland have also failed to detect the species within downstream sections of the Nicholson River system (D. Kelman (BRI) pers. comm.).

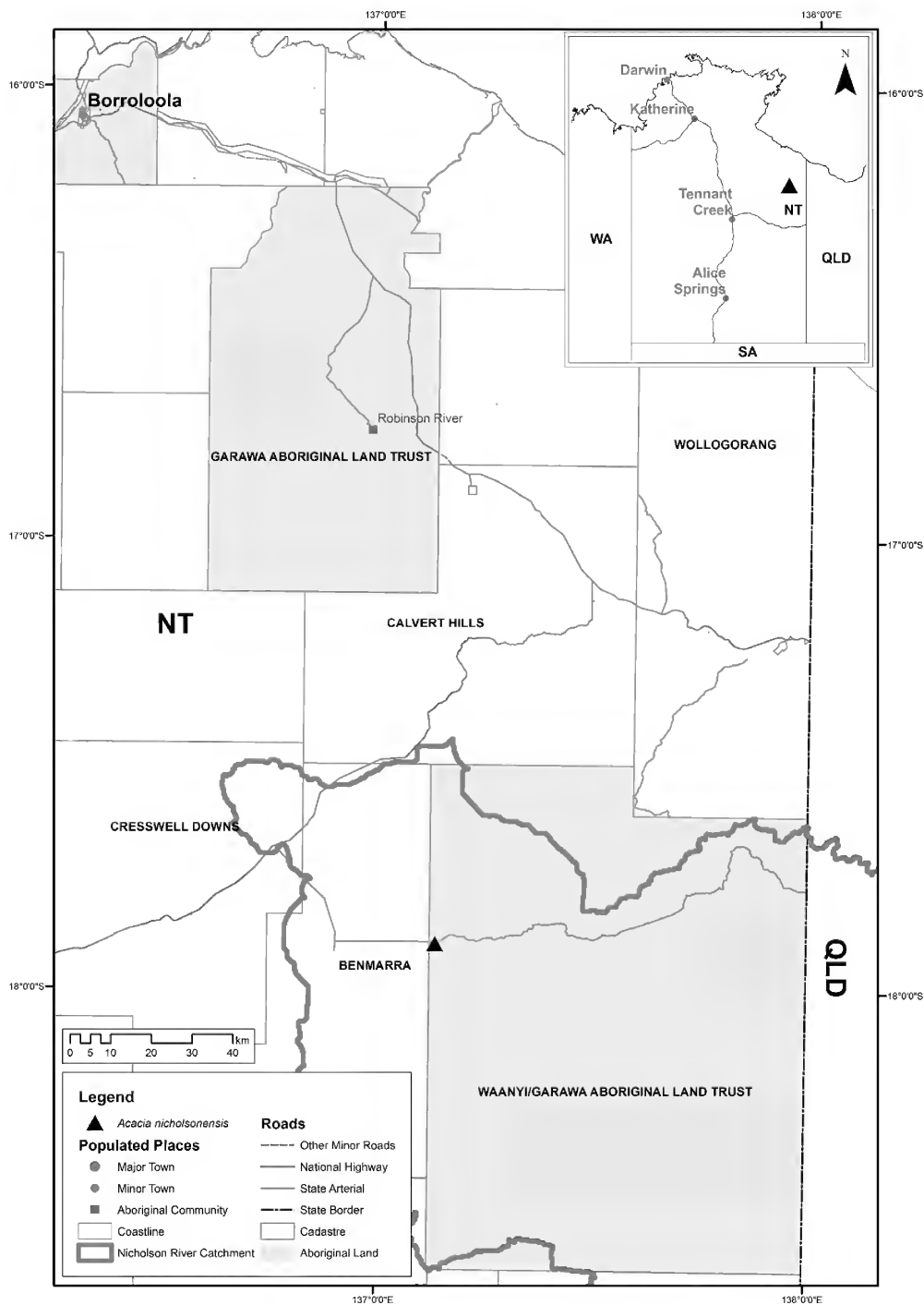


Figure 3. Distribution of *Acacia nicholsonensis* in the Northern Territory of Australia. Map grid: 1 degree increments of the Geocentric Datum of Australia (GDA94). Cadastral, road and populated place data supplied courtesy of Northern Territory Government; river catchment and topographic framework data courtesy of GeoScience Australia.

*Ecology and conservation status.* As with other poorly known *Acacia* species in the Northern Territory (e.g. Maslin & Cowie 2014), further research is required to better establish the population status, basic life-history parameters, longevity of seed, and the role that fire and other ecological processes play in the distribution and abundance of the species.

The known patches are highly likely to be genetically connected and are regarded as a single sub-population following the IUCN definition (IUCN Standards and Petition Subcommittee 2014) with field data estimates indicating the known global population is likely to be less than 12,500 mature individuals (as calculated from density estimates within patches).

Density of individuals and demographic structure of patches is thought to vary considerably, particularly in relation to recent fire history. Mature patches to the east and south of the Nicholson River crossing appear to occupy long-unburnt (>8 years) areas protected from fire by both the mesic riparian corridor and a constructed firebreak on the Waanyi/Garawa lands. Mature stands appear even-aged, comprised of individuals averaging 3–5 m in height and with a diameter at breast height (DBH) of 6–12 cm, forming dense (>1,000 stems/hectare) stands (Figure 4A) with a high ratio of mature to juvenile plants (<100 juveniles/hectare). A small proportion of mature individuals appear to exhibit some capacity to resprout basally after disturbance (low to moderate intensity fire; Figure 1C) although the vast majority appear particularly sensitive to wildfire.

Conversely, recently burnt (2012) patches on the western side of the South Nicholson River are characterised by high densities (>3,000 stems/hectare) of single-stemmed juvenile plants (0.1–1.5 cm DBH) with standing-dead mature plants readily identifiable at similar densities to those observed in unburnt patches. The high seedling/juvenile:adult ratios in these recently burnt areas and the growth form of juvenile plants with high shoot:root ratios suggests that the majority of regeneration is from soil-stored seed (Pate *et al.* 1990; Vaughton 1998; Figure 4B). The even-aged structure of mature stands further reinforces that the current demographics reflect periods of episodic mass recruitment from a seed bank following an external trigger, in this case likely to be fire. This response and population structure is similar to the regenerative response observed in many other obligate seeding tree and shrub species in fire-prone environments (e.g. Vaughton 1998; Pickup *et al.* 2003; Russell-Smith 2006; Barrett & Cochrane 2007).

The conservation status of the species has not previously been assessed against the IUCN criteria (IUCN 2012; IUCN Standards and Petition Subcommittee 2014). Initial estimates of the extent of occurrence, area of occupancy and the number of locations of *A. nicholsonensis* are within the range of the threatened categories outlined in the IUCN criteria (IUCN 2012; IUCN Standards and Petitions Subcommittee 2014) but are somewhat uncertain, given the lack of exhaustive survey within suitable habitats in the area and need for further evaluation of threats. The species should at this stage be listed as Data Deficient. The species is likely to be worthy of future listing following more exhaustive field survey of the global-population and evaluation of threats. However, given the limited number of collections, single geographic locality from which it is known and high probability that it has a relatively limited range, a 'Restricted Range' status appears appropriate in the Northern Territory.

The species appears vulnerable to unfavourable fire regimes, which have the potential to result in substantial population reductions within short time frames. Frequent, intense, late-dry season fires are known to have the potential to cause significant and rapid fluctuations in the abundance of woody shrub species in the Top End, particularly obligate seeding species (Russell-Smith *et al.* 1998; Russell-Smith *et al.* 2002; Russell-Smith 2006). This could be considered a significant threatening process for the global population and contribute to a future conservation listing under the IUCN Guidelines.

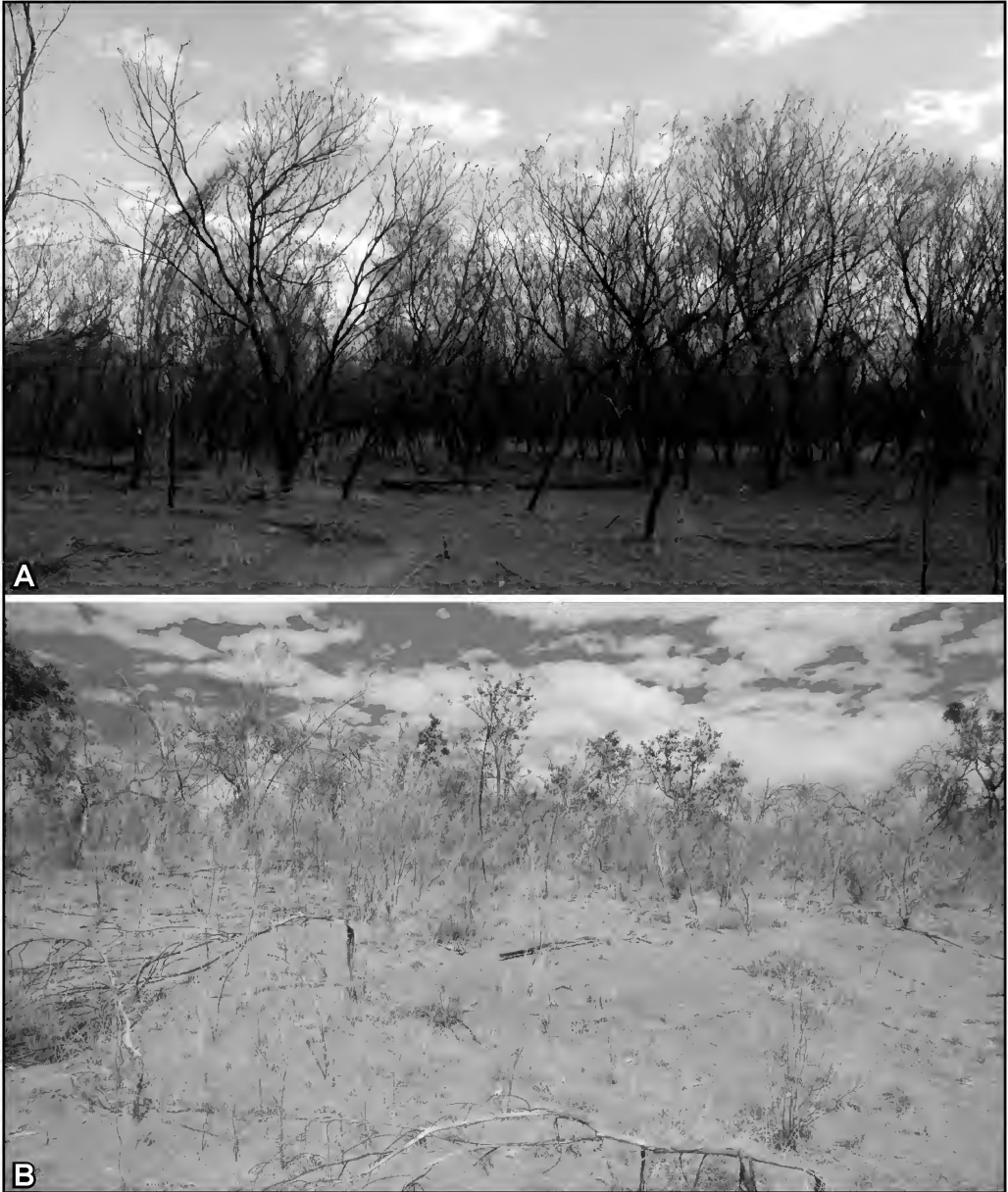


Figure 4. *Acacia nicholsonensis*. A – stand structure in long unburnt habitat; B – seedling regeneration in recently burnt habitat. Photographs by N. Cuff.

At the same time, local scale topographic barriers provide an element of fire protection, reducing the probability that the global population would be catastrophically affected by a single fire.

*Etymology.* The epithet is derived from the geographic locality of the type collection on the South Nicholson River, a drainage system to which the species appears to be restricted.

*Affinities.* The affinities of *A. nicholsonensis* to other members of sect. *Juliflorae* are currently unclear and largely speculative. *Acacia cyperophylla* F.Muell. ex Benth. is of a similar habit and occupies a similar habitat (along watercourses) to *A. nicholsonensis* in arid regions of Australia, although it is not currently known to occur north of c. 20° South (Wauchope) in the Northern Territory. *Acacia nicholsonensis* is possibly allied to *A. cyperophylla* given the similar combinations of ‘Minni Ritchi’ bark, inflorescence type, calyx lobe fusion and seed orientation characters. However, in most cases *A. cyperophylla* is readily separated from *A. nicholsonensis* by its glabrous, terete (although occasionally flat) phyllodes and its usual absence of a prominent indumentum on most surfaces.

Superficially, *A. nicholsonensis* appears similar to *A. fauntleroyi* (Maiden) Maiden & Blakely and *A. oncinophylla* Lindl., both of which are endemic to the south-west of Western Australia. The significant characters shared by these species include the densely lanate, resinous pods, long, linear, non-pungent phyllodes with short appressed hairs and slightly asymmetrically thickened margins, as well as the sepals and petals each united (connate) for >1/2 to 2/3 of their respective lengths. *Acacia nicholsonensis* and *A. fauntleroyi* also both have characteristically longer hairs on the phyllode nerves and margins. Despite these similarities, the very wide geographic separation would suggest that the actual phylogenetic relationships of *A. nicholsonensis* are unlikely to be close to these two species.

A number of features of *A. nicholsonensis* appear to be shared with *A. lysiphloia* F.Muell. with which it co-occurs along the Nicholson River, including ‘Minni Ritchi’ bark, persistent, triangular stipules, long, dense cylindrical spikes with long peduncles, and viscid pods with margins thickened on at least one side. This latter species is noted to readily intergrade with other *Acacia* species including *A. monticola* J.M.Black (Tindale *et al.* 2001a). Superficially, the gross morphology of *A. plectocarpa* subsp. *tanumbirinisensis*, which is the most common co-occurring *Acacia* species in the habitat of the new species, is also similar to *A. nicholsonensis*. ‘Minni Ritchi’-barked species are also known to hybridise with non-‘Minni Ritchi’-barked species in the Pilbara (e.g. *A. trachycarpa* × *tumida* var. *pilbarensis*) and Kimberley (e.g. *A. eriopoda* × *monticola*, *A. eriopoda* × *trachycarpa*) regions of Western Australia (Tindale *et al.* 2001b).

It is conceivable that the new species may be a hybrid between *A. lysiphloia* and *A. plectocarpa* subsp. *tanumbirinisensis*, although neither of these potential parent species possesses the combination of calyx or pod indumentum and seed orientation characters seen in *A. nicholsonensis*. Nursery growth trials with seed of the new species indicates that seedlings retain the morphological characters unique to the wild plants and do not exhibit characteristics beyond those superficial resemblances already mentioned to the possible parent taxa. It is hoped that future molecular studies will assist in fully resolving the affinities of the new species to other members of the section.

### Acknowledgements

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## New lectotypes and synonyms in the Western Australian genus *Scholtzia* (Myrtaceae: Chamelaucieae)

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### Abstract

Rye, B.L. New lectotypes and synonyms in the Western Australian genus *Scholtzia* (Myrtaceae: Chamelaucieae). *Nuytsia* 28: 159–167 (2017). Lectotypes are selected for the genus *Scholtzia* Schauer and for *S. capitata* F.Muell. ex Benth., *S. leptantha* Benth., *S. oligandra* F.Muell. ex Benth., *S. parviflora* F.Muell. and *Baeckea obovata* DC. *Scholtzia obovata* (DC.) Schauer is reinstated and *S. leptantha* reduced to a synonym of it. Two informal names are made redundant by the lectotypifications. Brief descriptions are provided for these taxa as now defined.

### Introduction

The myrtaceous genus *Scholtzia* Schauer belongs to the tribe Chamelaucieae DC. and comprises more than 40 species from south-western Australia. It is long overdue for revision, with a majority of its species undescribed. Application of some of its published names has been uncertain because they are based on mixed material, and the first species to have been placed in the genus, *S. obovata* DC., has been wrongly treated as a synonym of two more recent names, its true identity unclear.

These problems were investigated by borrowing type material and examining images of other type specimens. Lectotypes are selected for the genus and five of the published names that apply to *Scholtzia* species. Brief descriptions are provided for the species treated below since their previous descriptions are no longer applicable.

### Problems concerning *Scholtzia obovata*

When Schauer (1843, 1844) named *Scholtzia*, he based his description on material of the species then known as *Baeckea involucrata* Endl. However, he treated this species as a synonym of the older name *B. obovata* DC. and made the new combination *S. obovata* (DC.) Schauer. The very brief protologue for *B. obovata* (de Candolle 1828) gives some leaf and inflorescence characters that match a number of *Scholtzia* species including *B. involucrata*, but lacks other important characters such as stamen number.

Bentham (1867: 68, 70) maintained the treatment of *B. involucrata* as a synonym of *S. obovata*, although he twice noted that the latter was probably synonymous with his newly named species *S. leptantha* Benth. Druce (1917) concluded that *S. leptantha* should be placed in synonymy under *S. obovata* and published the new combination *S. involucrata* (Endl.) Druce.

Blackall and Grieve (1954, 1980) recognised Bentham's *S. leptantha*, but treated *S. obovata* as a synonym of *S. involucrata* despite the fact that Bentham (1867) referred to that species by the older epithet, i.e. calling it *S. obovata* rather than *S. involucrata*. *Scholtzia obovata* was not included in the lists of Western Australian species published by Green (1985) and Paczkowska and Chapman (2000), and was only reinstated on *FloraBase* (Western Australian Herbarium 1998–) in 2014 as a result of the current study.

### Identity of species collected by Augustus Oldfield

A second set of problems with the application of names for *Scholtzia* involves three species with type material collected by Augustus Oldfield reportedly at the Murchison River. Two of these names, *S. capitata* F.Muell. ex Benth. and *S. oligandra* F.Muell. ex Benth., are based on mixed material, each having a Drummond syntype belonging to a different species from the Oldfield syntype. A lectotype is therefore needed to establish the correct application of the names.

The third taxon, *S. parviflora* F.Muell., is based only on Oldfield's specimens yet has been applied at PERTH exclusively to material of a species or species complex that does not occur as far north as the Murchison River. The name *S. oligandra* has also been applied to specimens of this complex rather than to any of the species occurring at the Murchison River.

### Taxonomy

**Scholtzia** Schauer, *Linnaea* 17: 241 (1843). *Baeckea* sect. *Scholtzia* (Schauer) Baill., *Hist. Pl.* 6: 358 (1876). *Type*: *Baeckea involucrata* Endl. [= *Scholtzia involucrata* (Endl.) Druce], lectotype here designated.

*Pritzelia* Schauer, *Flora* 26: 407, 409 (1843), *nom. inval.*, *nom. nud.*

*Piptandra* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 35: 323 (1862). *Type*: *Piptandra spatulata* Turcz. [= *Scholtzia spatulata* (Turcz.) Benth.].

*Shrubs* prostrate to 3(–4) m high. *Leaves* opposite. *Peduncles* 1–many-flowered. *Petals* 1–4.5 mm long, white to bright pink. *Stamens* usually 4–25, in antisepalous groups or in a continuous circle. *Anthers* dehiscent by 2 terminal pores; connective gland fused to the anther cells. *Ovary* 1–3-locular; ovules either 2 per loculus and superposed, or 1 per loculus. *Style* with base inset; stigma small. *Fruits* indehiscent, inferior to c. 1/2 inferior, usually 1-seeded; seed usually extending the length of the cavity, 0.8–1.9 mm long, with a membranous testa.

*Typification.* Three names, *Scholtzia obovata*, its basionym *Baeckea obovata* and its presumed synonym *B. involucrata*, are listed in the protologue. The description of *Scholtzia* (Schauer 1843, 1844) as having 20 stamens and sepals about half as long as the petals, matches *S. involucrata*. *Scholtzia obovata* has about half that number of stamens and its sepals are much less than half as long as the petals (see description below). Both of the specimens Schauer (1844) indicated that he had seen, the Preiss No. 343 collection from near Perth and Huegel s.n., belong to *S. involucrata*. As he did not examine material of *S. obovata* and the protologue gave insufficient information to distinguish the species from *S. involucrata*, his error in assuming the two taxa were synonymous is understandable. Since Schauer was clearly basing his description of the new genus purely on *S. involucrata*, *B. involucrata* is selected here as the lectotype for the genus.

***Scholtzia capitata*** F.Muell. ex Benth., *Fl. Austral.* 3: 69 (1867). *Baeckea capitata* (F.Muell. ex Benth.) F.Muell., *Syst. Census Austral. Pl.* 54 (1883). *Type citation*: ‘Murchison River, Oldfield, Drummond, n. 134’. *Type collection*: Murchison River, Western Australia, 1859–1863, *A.F. Oldfield s.n.* (lecto: MEL 2278625, here designated; *isolecto*: K 000357124, MEL 2278624). *Excluded syntype*: unknown locality in Western Australia, 1835–1851, *J. Drummond* 134 (*syn*: G 0022679, K 000357122, 000357123 & 000357125, MEL 2278623) [= *S. sp.* Coomberdale (M.E. Trudgen 1724 & M.E. Trudgen) and *S. sp.* Yenyening Lakes (A.G. Gunness 2824) species group].

*Scholtzia* sp. Yerina Springs (N. Hoyle 517), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 22 April 2016].

*Shrub* 0.5–3 m high. *Petioles* 0.5–0.8 mm long. *Leaf blades* obovate to depressed-obovate, 2.5–4 mm long, 1.3–3.5 mm wide, not pointed, margins entire. *Peduncles* 8–16 mm long, 9–20-flowered; secondary axes up to 1.5 mm long. *Basal bracts* 1.8–2.3 mm long. *Pedicels* 0.5–1 mm long. *Flowers* 4.3–4.5 mm diam. *Hypanthium* 1.2–1.4 mm long, pitted-rugose. *Sepals* 0.6–1.2 mm long. *Petals* 1.5–2 mm long, white to medium pink, persistent in early fruit. *Stamens* 7–10, with 1–3 opposite each sepal. *Longest filaments* 0.3–0.4 mm long. *Ovary* inferior, 2-locular; ovules 1 per loculus. *Style* 0.7–1.3 mm long. *Fruits* c. 2/3 inferior, 2–2.5 mm long, 1- or 2-seeded; sepals erect or spreading; seed(s) 1.2–1.4 mm long.

*Distribution and habitat*. Occurs in and near Kalbarri National Park, mostly recorded on sandy soils.

*Phenology*. Flowers mainly from August to October, with mature fruits recorded from November to January.

*Selected specimens examined*. WESTERN AUSTRALIA: on Ogilvie Rd, 10 km W of Yerina Springs Rd, 9 Sep. 1984, *D.B. Foreman* 618 (PERTH); Kulla Kulla Hill, Yerina Springs Rd, 27 Sep. 1985, *N. Hoyle* 517 (PERTH); along Rabbit Proof Fence, Kalbarri National Park, 9 Jan. 1963, *R.D. Royce* 7801 (PERTH); S boundary of Kalbarri National Park, 12 May 1987, *R.H. Smith* 126 (PERTH); 0.85 km east from the CALM rangers offices on the road from Kalbarri to the North West Coastal Highway, Kalbarri National Park, 21 Sep. 2002, *M.E. Trudgen* 21635 (AD, BRI, CANB, NSW, PERTH).

*Typification*. The two syntypes belong to different species, *Oldfield s.n.* matching *S. sp.* Yerina Springs (N. Hoyle 517) and *J. Drummond* 134 matching the species group comprising *S. sp.* Coomberdale (M.E. Trudgen 1724 & M.E. Trudgen) and *S. sp.* Yenyening Lakes (A.G. Gunness 2824). However, all three phrase-named taxa conflict with the protologue in having only one ovule per loculus and they often have more than three flowers on most peduncles. *Scholtzia* sp. Coomberdale also conflicts in having a three-locular ovary. Note that Bentham (1867) gave accurate ovule numbers for ten other species of *Scholtzia*, a factor taken into consideration when selecting the lectotype for *S. oligandra* below.

In the protologue, Bentham (1867: 70) referred to Mueller’s comment that this taxon ‘may be a variety of *S. uberiflora* [F.Muell.], but it has not the peculiar foliage of that species’. Mueller’s (1864: 75) description of *S. capitata* as having rhomboid-obovate or oblong-obovate leaves certainly fits the Oldfield syntype rather than the Drummond syntype, and since Bentham was attempting to describe the taxon that had been assigned Mueller’s manuscript name of *S. capitata*, it seems more appropriate to base the name on this syntype than the Drummond specimen. The Oldfield specimen also fits the protologue more closely and has the advantage of having a locality.

The lectotype, MEL 2278625, was selected from among the Oldfield specimens because it is of good quality, was viewed by Bentham, and is the only one to have a label attached giving Oldfield's collection details 'Twiggy shrub 8–10 ft fl white Thicket ?Mitta ?Ra [handwriting unclear]'.

*Notes.* Choosing the Oldfield specimen as the lectotype renders *S. sp.* Yerina Springs a synonym of *S. capitata*. *Scholtzia capitata* keys out accurately among the named species included in Blackall and Grieve (1980: 72), although the illustration is inaccurate in showing the ovary as having two ovules per loculus and is possibly based on mixed material.

**Scholtzia obovata** (DC.) Schauer, *Linnaea* 17: 241 (1843). *Baeckea obovata* DC., *Prodr.* 3, 230 (1828). *Type citation*: 'In Nôva-Hollandia ad Portem regis Georgii (v. v.)'. *Type collection*: 'King George Sound' [probably Shark Bay area (see typification)], Western Australia, ex *Benjamin Delessert herbarium* (*lecto*: G 00486349, here designated; possible *isolecto*: G 00418258).

*Scholtzia leptantha* Benth., *Fl. Austral.* 3: 69 (1867). *Baeckea leptantha* (Benth.) F. Muell., *Syst. Census Austral. Pl.* 54 (1883). *Type citation*: 'Seashore, Sharks Bay, Milne; also in Herb. R. Brown from Herb. Mus. Par.' *Type collection*: Shark Bay, Western Australia, *Milne s.n.* (*lecto*: K 000357120, here designated; *isolecto*: K 000557199 & 000357121). *Syntype*: coast of New Holland, R. Br. Herbarium ex Herb. Mus. Par. (BM *n.v.*) [identity unknown].

*Illustration.* W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 71 (1980) [as *Scholtzia leptantha*].

*Shrub* 0.4–1.5 m high. *Petioles* 0.4–0.6 mm long. *Leaf blades* obovate to almost circular, 2.5–4.5 mm long, 1.5–3 mm wide, not pointed, lower margins denticulate or often ciliolate. *Peduncles* 5–13 mm long, 3–15-flowered; secondary axes up to 1.3 mm long. *Bracts* 1–2.5 mm long. *Pedicels* up to 1 mm long. *Flowers* 3–4.2 mm diam. *Hypanthium* 1.8–2.5 mm long, somewhat 5-ribbed, at least in distal half and on herbaceous base of each sepal. *Sepals* 0.3–0.6 mm long. *Petals* 1–1.6 mm long, white or pale pink, persistent in early fruit. *Stamens* 8–11, with 1–3 opposite each sepal. *Longest filaments* 0.4–0.6 mm long. *Ovary* inferior, 2-locular; ovules 2 per loculus. *Style* 0.5–1.4 mm long. *Fruits* c. 3/4 inferior, 1.7–2.3 mm long; sepals scarious, erect, with margin incurved; seed unknown.

*Selected specimens examined.* WESTERN AUSTRALIA: Tamala Station, 15 Aug. 1970, *T.E.H. Aplin* 3517 (PERTH); 9.6 mi. [15.5 km] towards Loop from Kalbarri Stn, 9 Jan. 1970, *M.I.H. Brooker* 2386 (PERTH); fire plots on 10 mile track, Peron Peninsula, 14 Oct. 2008, *R.J. Cranfield* 23297 (PERTH); Babbage Island, 17 Aug. 1977, *H. Demarz* 6587 (PERTH); lagoon c. 3 km N of Denham, 17 Oct. 1983, *S.J. Forbes* 1650 (PERTH); Shark Bay, Oct. 1877, *F. Mueller s.n.* (MEL 76013); Monkey Mia, 23 Sep. 1996, *G. Perry* 578 (AD, MEL, NSW, PERTH); Miaboolia Beach, c. 9 km N of Carnarvon, 26 Sep. 1987, *P.G. Wilson* 12636 (CANB, PERTH).

*Distribution and habitat.* Occurs from north of Carnarvon south to Kalbarri National Park, mainly on sand dunes, sand over limestone and other coastal habitats.

*Phenology.* Flowers mainly from August to November.

*Typification of Baeckea obovata.* The locality of King George Sound given in the protologue is clearly inaccurate since the genus *Scholtzia* does not occur there or anywhere close by, being absent from the entire south coast of Western Australia. French expeditions are not known to have collected at

any locations within the range of *Scholtzia* apart from Shark Bay and Swan River (see George 2009), towards either end of the range. While numerous species occur in the central part of the range, only *S. involucrata* occurs at Swan River and only *S. obovata* at Shark Bay.

Within the de Candolle (G-DC) collection, a single sheet has been located with the name *B. obovata* in A.P. de Candolle's writing attached to the right-hand bottom corner. Three specimens are attached to this sheet as follows:

1. G 00486348, labelled as 'Melaleuca' from the east coast of New Holland, 'Mus: de Paris 1821'.
2. G 00486349, labelled as coming from 'King George Sound' with the name Monsieur B. Delessert and date 1816 but no individual identification to genus or species. It appears that this specimen was donated from the Benjamin Delessert herbarium, which was then located in Paris (L. Gautier pers. comm.).
3. G 00464461, labelled as 'Leptospermum microphyllum' from New Holland, again with B. Delessert and 1816.

Another sheet, this time not from the G-DC collection, is labelled as a *Melaleuca* [L.] from 'port du roi George' on the south-west coast and the date given as 1803 (G 00418258) and could possibly be a duplicate of G 00486349. All four specimens are very similar in overall appearance.

Of the three specimens mounted on the single sheet that is housed in de Candolle's collection, G 00486349 is the best material in having a number of protruding peduncles attached to it and in being the largest piece, and also it is the only one to match the protologue in giving the locality as being from King George Sound; it is therefore selected here as the lectotype. The material may have been collected by Leschenault de la Tour, who collected at Shark Bay on *Naturaliste* under Baudin in 1801, and at both Shark Bay and King George Sound on *Géographe* under Hamelin in 1803 (George 2009). The other two pieces mounted on the same sheet are assumed to be from separate collections because of the differences on their labels.

*Typification of Scholtzia leptantha.* Two specimens were cited in the protologue for *S. leptantha* in *Flora Australiensis* (Bentham 1867), with the Milne collection from Shark Bay listed first and apparently given prominence (see type citation above). As there is copious, good material of the Milne collection, one of its duplicates (K 000357120) is selected here as the lectotype. The K 000357120 sheet contains probably the best inflorescences, while the K 000557199 sheet is considered the poorest of the three sheets. *Global Plants* does not have any images of the other syntype.

*Notes.* Following Bentham (1867: 67–70), Blackall and Grieve (1980) distinguish this species [as *S. leptantha*] from *S. umbellifera* F.Muell. in having distinct anther cells opening in slits rather than united anther cells opening by terminal pores. However, the differences between the anthers of the two taxa are more subtle than this, with both species having united cells opening in terminal pores, but with a more obvious connective gland in *S. obovata*. The anthers of *S. obovata* certainly do not resemble the illustration provided by Blackall and Grieve (1980: 71), which shows long slits; instead the pores are more oblong. *Scholtzia obovata* tends to have broader leaves than *S. umbellifera* and usually a shorter style.

**Scholtzia oligandra** F.Muell. ex Benth., *Fl. Austral.* 3: 70 (1867). *Baeckea oligandra* (F.Muell. ex Benth.) F.Muell., *Syst. Census Austral. Pl.* 54 (1883). *Type citation*: ‘Drummond (5th Coll?), n. 147; Murchison River, Oldfield.’ *Type collection*: near the mouth of Murchison River, Western Australia, 1859–1863, *A.F. Oldfield s.n.* (*lecto*: MEL2190010, here designated; *isolecto*: K 000357109). *Excluded syntype*: unknown locality in Western Australia, ?1847–1849, *J. Drummond* coll. ?5, n. 147 (*syn*: K 000357114 & 000357115, MEL 2190008 & 2190009) [= *S. aff. parviflora*]

*Scholtzia* sp. Kalbarri (N. Hoyle 623) in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 402 (2000); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 22 April 2016].

*Shrub* often cushion-like and 0.1–0.9 m high, rarely recorded up to 1.5 m high. *Petioles* 0.3–0.8 mm long. *Leaf blades* narrowly obovate to almost circular, 2–5 mm long, 0.5–4 mm wide, thin or up to 0.6 mm thick, not pointed, margins denticulate to ciliolate or entire. *Peduncles* 2.5–10 mm long, mostly 2–9-flowered; secondary axes absent or up to 0.6 mm long. *Bracts* 1–2 mm long, usually deciduous. *Pedicels* up to 0.5 mm long. *Flowers* 4.5–6 mm diam. *Hypanthium* 0.9–1.2 mm long, smooth or somewhat wrinkled, not pitted. *Sepals* 0.5–1 mm long, somewhat to strongly ridged. *Petals* 1.5–2.5 mm long, pale pink or white, deciduous. *Stamens* 5–8, with 1–3 opposite each sepal. *Longest filaments* 0.4–0.7 mm long. *Ovary* inferior, 2- or 3-locular; ovules 2 per loculus. *Style* 0.6–0.9 mm long. *Fruits* c. 2/3 inferior, 1.6–1.9 mm long, 1-seeded as far as known; sepals scarious, erect to spreading, the margin recurved; seed 1.2–1.3 mm long.

*Selected specimens examined.* WESTERN AUSTRALIA: Red Bluff, near Kalbarri, 12 Oct. 1981, *L.A. Craven* 7056 (PERTH); Grandstand Rock Lookout, Kalbarri National Park, 13.2 km c. S of Kalbarri, 28 Sep. 1985, *N. Hoyle* 537 (CANB, PERTH); Eagle Gorge, S of Kalbarri in Kalbarri National Park, 19 Sep. 1994, *A.G. Gunness* 2363 (AD, BRI, PERTH); c. 30 km S of Red Bluff, 3 Dec. 1978, *R.J. Hnatiuk* 780377 (PERTH); just below carpark on pathway to Natural Bridge, Kalbarri National Park, 6 Sep. 2016, *B.L. Rye* 290158 (PERTH); coastal road between Kalbarri and Northampton, 1.45 km S from the Kalbarri post office, 23 Sep. 2002, *M.E. Trudgen* 21659 (MEL, NSW, PERTH).

*Distribution and habitat.* Occurs near the coast in the Kalbarri area south to near Lucky Bay (west of Binnu), on coastal cliffs and dunes, in sand over limestone or sandstone.

*Phenology.* Flowers mainly from July to November, with mature fruits recorded from August to December.

*Typification.* Mueller’s manuscript names *Baeckea oligandra* F.Muell. ms and *Scholtzia oligandra* F.Muell. ms for this species were applied to the Oldfield collection. Bentham adopted this epithet but based his description also on a second specimen, *J. Drummond* 147. In the protologue, Bentham (1867: 70) noted that ‘Drummond’s specimens have numerous flowers, but far advanced, and have lost their stamens. In Oldfield’s, the flowers are very few, but more perfect’. Perhaps because of these deficiencies in both specimens, he stated ‘both appear, however, to belong to one species’. Presumably he based floral characters including the stamen number of about five on the Oldfield collection and the fruit description on Drummond’s collection. Unlike all the other descriptions of *Scholtzia* species in *Flora Australiensis*, the description of *S. oligandra* does not indicate the number of ovary loculi, although recording the fruit as ‘separating into 2 hard, usually 1-seeded cocci’ implies that the ovary is bilocular.

The fruiting Drummond material (e.g. K 000357114) matches specimens (e.g. *G.J. Keighery* 16378) that are currently housed at PERTH as *S. aff. parviflora*, although many had previously been identified as *S. oligandra*. However, they conflict with the protologue in having only one ovule per loculus. Like all other species of *Scholtzia* they have indehiscent fruits, so fail even to match Bentham's description of the fruit. The Drummond specimens also have up to six flowers per peduncle rather than the maximum of three indicated in the protologue, although most peduncles do have about three flowers.

Both the protologue and the Oldfield specimens from Murchison River (K 000357109 & MEL 2190010) match material at PERTH that has been housed under the phrase name *S. sp. Kalbarri* (N. Hoyle 623), except in the description of the peduncles as being 1–3-flowered and in the faulty description (see above) of the fruit as separating into two cocci. The ovary in this species is either 2-locular or 3-locular, in about equal frequency. Unfortunately it is not possible to tell from the few fragments of dissected flowers in a packet attached to K 000357109 whether the ovary is 2- or 3-locular, and the stamens are missing. The MEL specimen is also deficient in flowers, with just one intact flower in a packet, but it gives the more detailed locality of 'Sand Hills nr mouth of Murchison', which agrees well with the distribution of *S. sp. Kalbarri*. The limited floral material is sufficient to show that the hypanthium and sepals of the K and MEL specimens match *S. sp. Kalbarri*, and vegetative characters, such as the thick leaves, are a very good match. If the Oldfield material had been in full flower, it would have been clear that the peduncles are not usually as short and few-flowered as indicated by Bentham based on the fruiting Drummond material.

MEL 2190010 is selected here as the lectotype since it has the original collector's details of the locality and a brief description of the plant, one intact flower, and clear indications that it was examined by Bentham. The isolectotype, K 000357109, lacks the original collector's notes and has no intact flowers.

*Notes.* Selection of the Oldfield collection as the lectotype means that *S. sp. Kalbarri* is reduced here to a synonym of *S. oligandra*. Blackall and Grieve's (1980: 74) key agrees with this delimitation of *S. oligandra* in keying it out as having a smooth hypanthium on page 72 and in indicating that it has two ovules per loculus on page 74, but matches the *S. parviflora* complex in keying it out as having very short peduncles. Peduncles on *S. oligandra* are up to 10 mm long, compared with a maximum of 4 mm long in *S. parviflora s. lat.*, and on average have more numerous flowers.

This species has been described as a cushion plant where it occurs in exposed locations. It often produces somewhat thickened, fleshy leaves, but flatter leaves are also common. Some specimens may have all flowers with one stamen opposite each sepal (1,1,1,1 = 5) as all flowers examined so far on N. Hoyle 537 appear to be 5-staminate.

***Scholtzia parviflora*** F.Muell., *Fragm.* 4: 76 (1864). *Baeckea parviflora* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.* 54 (1883). *Type citation:* 'In planitiebus ad flumen Murchison. *Oldfield*'. *Type collection:* Dandaragan valley, Western Australia, 1859–1863, A.F. Oldfield 133 (*lecto:* MEL 2194369, here designated; *isolecto:* K 000357110). *Syntype:* middle of sandplain, Western Australia, 1859–1863, A.F. Oldfield 130 (MEL 2194371).

*Illustration.* W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildfl.* 3A: 72 (1980).

*Shrub* 0.6–3 m high. *Petioles* 0.1–0.5 mm long, often poorly defined. *Leaf blades* broadly obovate or obtriangular, 1.5–4 mm long, 1.5–3 mm wide, upper margins commonly denticulate; adaxial surface with a narrowly ridged midrib, which occasionally protrudes from the leaf apex by up to 0.1 mm;

adaxial surface usually with several veins visible on each side of the midvein. *Peduncles* 0.7–2 mm long, 1–3-flowered. *Bracts* deciduous, 0.7–1.5 mm long. *Pedicels* 0.3–0.9 mm long. *Flowers* 3–4.5 mm diam. *Hypanthium* 0.8–1.3 mm long, deeply pitted-rugose. *Sepals* 0.3–0.6 mm long. *Petals* 1–1.8 mm long, pale to medium pink, deciduous. *Stamens* 4 or 5, with 0–2 opposite each sepal. *Longest filaments* 0.25–0.3 mm long. *Ovary* inferior, (1)2-locular; ovules 1 per loculus. *Style* 0.4–0.75 mm long. *Fruits* (most mature ones examined) *c.* 2/3 inferior, *c.* 1.5 mm long, *c.* 1.6 mm wide; sepals scarious,  $\pm$  erect or incurved; seed not seen at maturity.

*Selected specimens examined.* WESTERNAUSTRALIA: Jurien Bay Rd, 29 Aug. 1938, *W.E. Blackall* 3656 (MEL, PERTH); *s. loc.*, *s. dat.*, *J. Drummond s.n.* (MEL 76449); Moore River Bridge at Regans Ford, 31 Aug. 1966, *R. Filson* 8423 (PERTH); on Badgingarra Rd 1 km N from Dandaragan–Moora Rd, 30 Aug. 1984, *D. Foreman* 395 (PERTH); Hill River Spring, 21 July 1934, *C.A. Gardner s.n.* (AD, CANB, NSW, PERTH); Watheroo National Park W boundary of Warro Farm, 15 Aug. 1987, *E.A. Griffin* 4508 (PERTH); Minyulo Nature Reserve, 500 m S of northern boundary, 10 Sep. 2008, *K. Himbeck* KJH 28 (PERTH); crossing of Minyulo Brook by Brand Hwy, *c.* 4.5 km NNW of Cataby, 7 Sep. 1977, *E.N.S. Jackson* 3212 (AD); Moore River, Gillingarra Nature Reserve, 18 Sep. 2008, *G.J. Keighery* 17324 (PERTH); Brand Hwy, 49 km S of Eneabba, near turnoff to Jurien, 6 Oct. 1982, *A. Strid* 20686 (PERTH).

*Distribution and habitat.* Extends from the Hill River area south to Moore River and east to Watheroo National Park, usually along watercourses or associated with other wetlands, recorded as dominant at one swamp. On watercourses it is often associated with Marri or Flooded Gum and elsewhere sometimes with Prickly Bark (*Eucalyptus todtiana*) or *Banksia prionotes*.

*Phenology.* Flowers mainly from late June to October, with young fruits recorded from September to November.

*Chromosome number.* A chromosome count of  $n = 11$  (Rye 1979: 571) has been recorded for the *S. parviflora* complex [as *S. parviflora*]. The voucher specimen does not match the typical variant, *S. parviflora s. str.*; instead it is currently identified as *S. aff. parviflora*.

*Typification.* The type material of *S. parviflora* was apparently collected well south of the Murchison River. Two Oldfield specimens (MEL 2194369 & 2194371) were available to Mueller and later examined by Bentham. One has a known locality as the collector's label records 'Straggling shrub 6–8 ft Dandaragan valley – 133'. This certainly is well within the geographic range of the *S. parviflora* species complex, which extends only as far north as Northampton, *c.* 60 km south of the Murchison River. The other specimen lacks a locality, being recorded as 'Very much branched shrub 2–4 ft. Middle of sandplain 130', and also lacks flowers. Both are similar to more recent specimens from the Dandaragan area but do not match material collected from the far north of the range near Northampton. Mueller apparently used *A.F. Oldfield* 130 as the basis for giving the locality as 'in planitiebus' but must have relied on *A.F. Oldfield* 133 for the description of the flowers. Consequently the latter specimen is selected as the lectotype.

*Notes.* Bentham (1867: 70) based his description of Mueller's species on two Drummond specimens as well as the type material, noting that the leaves in Drummond's specimens 'are smaller, more spreading, more orbicular, and less narrowed at the base' than in Oldfield's. The Drummond specimens have leaves of similar size and shape to those of specimens of *S. aff. parviflora* from the Northampton

area. *Scholtzia parviflora* s. str. tends to have larger, more spatulate leaves with visible veins, each terminating in a tooth.

*Scholtzia* aff. *parviflora* differs from *S. parviflora* in having more petal-like sepals, with the outer ones distinctly larger (0.6–1.1 mm long) than the inner ones, with all sepals widely spreading in fruit. Other differences, such as leaf shape, show too much overlap to be reliably applied and it is possible that a few specimens are somewhat intermediate in their sepals. The *S. parviflora* complex shows a large degree of variation, needing further study to determine whether more than one species should be recognised or whether it would be more appropriate to recognise subspecies.

The most common stamen arrangement in *S. parviflora* s. str., and in the complex as a whole, has a total of five stamens, with paired stamens opposite two sepals, a solitary stamen opposite one sepal and the remaining two sepals lacking a stamen (i.e. 2,0,1,2,0 = 5). Note that this is a different arrangement of the stamens from that found in 5-staminate flowers of *S. oligandra* (see above).

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## SHORT COMMUNICATION

**Two new synonyms in Western Australian Proteaceae: *Isopogon heterophyllus* and *I. teretifolius* subsp. *petrophiloides***

*Isopogon* R.Br. is a southern Australian genus of Proteaceae. Thirty-five species and seven additional infraspecific taxa were recognised when the genus was treated in Volume 16 of *Flora of Australia* (Foreman 1995). Two of these taxa have proved to be insufficiently distinctive to be retained. *Isopogon heterophyllus* Meisn. is reduced here to a synonym of *I. formosus* R.Br. subsp. *formosus*, and subspecies are no longer recognised for *I. teretifolius* R.Br., with subsp. *petrophiloides* (R.Br.) Foreman reduced to synonymy.

***Isopogon formosus*** R.Br., *Trans. Linn. Soc. London* 10: 72 (1810); *Atylus formosus* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 577 (1891). *Type*: King George Sound [Western Australia], December 1801, R.Brown s.n. [Bennett No. 3248] (*syn*: BM 001191226 & 000991919, K 000736631 & 00736632, MEL 1531489, NSW 131384).

*Common name*. Rose Coneflower.

*Notes*. This species has two significant disjunctions dividing its known range into western, central and eastern areas. Two geographically separated subspecies are recognised, with subsp. *dasylepis* (Meisn.) Foreman occupying the western area and subsp. *formosus* the other two areas.

Foreman (1995: 208) was concerned that his recognition of two subspecies was ‘not completely satisfactory, since a considerable number of specimens of *I. formosus* cannot be convincingly assigned to either subspecies’. While it is true that the distinguishing characters used by Foreman do not allow a complete separation, our assessment is that foliar and indumentum differences support their continued recognition (Table 1). All specimens at the Western Australian Herbarium (PERTH) have been assigned to a subspecies.

**Table 1.** Diagnostic characters for the two subspecies of *Isopogon formosus*.

	<b>Subspecies <i>dasylepis</i></b>	<b>Subspecies <i>formosus</i></b>
<b>Leaves</b>	tightly involute throughout; adaxial surface scarcely visible	variably involute; adaxial surface always partially visible, although sometimes only on the ultimate divisions or at the junctions where they arise
<b>Stem directly below inflorescence</b>	glabrous or occasionally with a few short hairs	densely hairy, often with long, spreading hairs
<b>Involucral bracts</b>	glabrous or rarely with a few short hairs on abaxial surface	hairy on abaxial surface
<b>Cone scales</b>	glabrous on the distal half of abaxial surface	hairy throughout on abaxial surface

**a. *Isopogon formosus* subsp. *dasylepis*** (Meisn.) Foreman, *Fl. Australia* 16: 479 (1995). *Isopogon formosus* var. *dasylepis* Meisn. in A.L.P.P. de Candolle, *Prodr.* 14: 278 (1856). *Type citation*: ‘Drumm, n. 295! Preiss, n. 670!’. *Type specimens*: ‘In solo limoso planitie ad flum Vasse, Sussex. Country’ [Vasse River, Western Australia], 17 December 1839, *J.A.L. Preiss* 670 (*syn.* LD 1315766, MEL 1532914 & 1535661); [no precise locality, Western Australia], *s. dat.*, *J. Drummond* 295 (*syn.* K 000736630, LD 1829489, MEL 1532915).

*Illustration*. J.R. Wheeler, N.G. Marchant & M. Lewington, *Fl. South West* 2: 839 (2002).

*Distribution*. Extends from the Busselton area east to Noggerup and south to the Scott River.

*Phenology*. Flowers recorded mainly from June to December.

*Conservation status*. Not considered to be at risk.

*Notes*. As indicated in Table 1, subsp. *formosus* is hairier below and on the inflorescences than subsp. *dasylepis*, but this difference is not always evident in fruiting material, in which the indumentum may be lost. A specimen from Noggerup (*A. Webb & C. Prowse* AW 2162) has hairier involucral bracts than is usual for this subspecies.

**b. *Isopogon formosus* R.Br. subsp. *formosus***

*Isopogon formosus* var. *eriolepis* Meisn. in A.L.P.P. de Candolle, *Prodr.* 14: 278 (1856). *Type citation*: ‘Preiss, n. 687!’. *Type specimens*: ‘In arenosis sylvae circa oppid. Albany’ [near Albany, Western Australia], 14 October 1840, *J.A.L. Preiss* 687 (*syn.* LD 1357877, MEL 1532913 & 1535660).

*Isopogon heterophyllus* Meisn. in J.G.C. Lehmann, *Pl. Preiss.* 1: 504 (1845). *Atylus heterophyllus* (Meisn.) Kuntze, *Revis. Gen. Pl.* 2: 577 (1891). *Type*: ‘in region interior, Australiae merid.-occid.’ [inland in the south-west of Western Australia], October 1840, *J.A.L. Preiss* 672 (*syn.* LD 1359077).

*Isopogon occidentalis* D.A.Herb, *J. & Proc. Roy. Soc. W. Australia* 6: 105 (1921). *Type citation*: ‘Cranbrook (Dr. Stoward), East from Solomon’s Well; Stirling Range (Dr. A. Morrison)’. *Type specimens*: ‘E from Solomon’s Well’ [Stirling Range, Western Australia], 28 September 1902, *A. Morrison s.n.* [*C.A. Gardner* 360a] (*syn.* PERTH 04230191); Cranbrook, Western Australia, 22 September 1911, *Dr Stoward s.n.* (*syn.* PERTH 04230027).

*Illustrations*. W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildflowers* 1: 148 & 149 (1988) [as *I. formosus* and *I. heterophyllus*]; J.R. Wheeler, N.G. Marchant & M. Lewington, *Fl. South West* 2: 839 (2002).

*Distribution*. Extends in a near-coastal belt from Walpole north-east to Hopetoun and from Dalyup east to Cape Arid National Park. Survey is required to assess whether the apparent large disjunction of over 130 km between Hopetoun and Dalyup is real and not a collecting gap. We note that a number of other taxa from varied plant families have a similar disjunction in that region, including *Thryptomene saxicola* (Hook.) Schauer, which has a very similar overall distribution to *I. formosus* (Western Australian Herbarium 1998–).

*Phenology.* Flowers recorded mainly from May to November.

*Conservation status.* Not considered to be at risk.

*New synonym.* *Isopogon heterophyllus* was initially described from fruiting material with no flowers. Gardner (unpublished data; ms housed at Western Australian Herbarium) assigned material from the Stirling Range to this species but noted that it was ‘perhaps only a variety’ of *I. formosus*. Bentham (1870) and Blackall and Grieve (1988) separated *I. heterophyllus* from *I. formosus* by its less divided leaves, which they indicated as being sometimes simple and sometimes divided only towards the apex but not divided as extensively as in *I. formosus*. Few specimens previously assigned to *I. heterophyllus* have any simple leaves and those that do mostly occur in the Stirling Range and adjacent areas.

Foreman (1995) noted that specimens of *I. heterophyllus* had been confused with *I. formosus*. He distinguished *I. heterophyllus* by its ‘thicker leaves which are characteristically grooved and wrinkled when dry’, ‘generally somewhat longer’ flowers and more villous cone scales (Foreman 1995: 205), but did not mention any difference in the degree to which the leaves were divided. In his key Foreman separated the two taxa as ‘Flowers to c. 25 mm long; leaves to 5.5 cm long, smooth’ in *I. formosus* compared with ‘Flowers to c. 30 mm long; leaves to 18 cm long, longitudinally wrinkled, thicker than above’ in *I. heterophyllus*.

*Isopogon heterophyllus* is reduced herein to a synonym of *I. formosus* subsp. *formosus* because no reliable differences could be found in any of the characters noted above. Among those specimens assigned by Foreman to one or other species, there appears to be a complete intergradation in leaf morphology and no separation in distribution. Cone scales vary from sparsely to very densely hairy, and flower length shows a great overlap between the two groups of specimens.

**Isopogon teretifolius** R.Br., *Trans. Linn. Soc. London* 10: 71 (1810); *Atylus teretifolius* (R.Br.) Kuntze, *Revis. Gen. Pl.* 2: 577 (1891). *Type citation*: ‘In Novae Hollandiae orâ australi, Lewin’s Land; in ericetis collibusque saxosis. (ubi v.v.)’. *Type specimen*: King George Sound, December 1801, *R. Brown s.n.* [Bennett No. 3246] (*syn*: BM000991909 [which appears to comprise material from Brown’s Herbarium and a ‘Dryander duplicate’, the latter of which is mounted to the lower left-hand corner of the sheet]).

*Isopogon petrophiloides* R.Br., *Suppl. Prodr. Fl. Nov. Holl.* 7 (1830). *Isopogon teretifolius* subsp. *petrophiloides* (R.Br.) Foreman, *Fl. Australia* 16: 481 (1995). *Type*: south-west coast of New Holland [Stirling Range to south coast of Western Australia], 1828–1829, *W. Baxter s.n.* (?*holo*: BM000991908).

*Illustrations.* W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildflowers* 1: 146 & 147 (1988) [as *I. teretifolius* var. *teretifolius* and var. *petrophiloides*]; D.B. Foreman, *Fl. Australia* 16: Figure 100 N & O (1995) [as *I. teretifolius* subsp. *teretifolius*].

*Distribution.* This species has quite a wide distribution in the south-west of Western Australia, occurring along the south coast between Denmark and Hopetoun, extending north-east to Alexander Morrison National Park and inland to near Hyden.

*Phenology.* Flowers recorded mainly from July to December but occasionally flowering throughout the year.

*Conservation status.* Not considered to be at risk.

*Common name.* Nodding Coneflower.

*Type locality.* Foreman (1995: 207) mistakenly gave the type locality of *I. petrophiloides* as ‘near William’ in an apparent misreading of the hand-written label on BM 000991908, which actually reads ‘Mr William Baxter’. Baxter collected a number of species on and close to the Stirling Range (see George 2009: 286), and there seems little doubt that this was one of them.

*New synonym.* The type of subsp. *petrophiloides* is referable to a rare variant of *I. teretifolius* that has simple leaves; however, this variant can no longer be recognised as it completely intergrades with typical *I. teretifolius*. The simple-leaved variant occurs only in the vicinity of Stirling Range and an example of its intergradation with the typical variant is seen in two specimens, *D.J.E. Whibley* 5237 & 5238 (PERTH), collected 60 km north-east of Albany in 1974. *Whibley* 5238 shows the full range of leaf variation in *I. teretifolius*, from the typical deep leaf divisions through to simple leaves, whereas *Whibley* 5237 has all of its leaves either simple or with just a slight division into two or three short lobes at the apex.

Interestingly, the rare occurrence of simple leaves in *I. formosus* subsp. *formosus*, as discussed for that taxon above, is also largely restricted to the Stirling Range area where the simple-leaved variant of *I. teretifolius* occurs. Two other taxa that have intergrading variants with simple and divided leaves are *I. divergens* R.Br. and *I. scabriusculus* Meisn. subsp. *scabriusculus*.

*Notes.* Foreman (1995) gave a broader delimitation of *I. teretifolius* than is now accepted because he included the simple-leaved species now known as *I. sp.* Newdegate (D.B. Foreman 771) under subsp. *petrophiloides*. *Isopogon* sp. Newdegate had been recognised as distinct in 1962, when it was given the manuscript name *I. nutans* C.A. Gardner ms on the label of *C.A. Gardner* 13988. It is readily distinguished from *I. teretifolius* by its glabrous branchlets and young leaves, involucre bracts with hairs only on the central area, and tepals with a glabrous claw and densely hairy limb. This new species will be formally described in a forthcoming publication.

### Acknowledgements

Types were examined using the JStor *Global Plants* website and Sweden’s Virtual Herbarium.

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## A revision of the *Hibbertia lineata* (Dilleniaceae) species group

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### Abstract

Thiele, K.R. A revision of the *Hibbertia lineata* (Dilleniaceae) species group. *Nuytsia* 28: 173–191 (2017). The *Hibbertia lineata* Steud. species group comprises six species endemic in south-western Western Australia. *Hibbertia lineata* is recircumscribed to include *H. recurvifolia* (Steud.) Benth., and *H. polyanctra* K.R. Thiele *sp. nov.*, *H. depilipes* K.R. Thiele *sp. nov.*, *H. verrucosa* (Turcz.) Benth., *H. microphylla* Steud. and *H. papillata* J.R. Wheeler are described and discussed. A key is provided to all taxa.

### Introduction

Five Western Australian species of *Hibbertia* Andrews (*H. lineata* Steud., *H. recurvifolia* (Steud.) Benth., *H. verrucosa* (Turcz.) Benth., *H. microphylla* Steud. and *H. papillata* J.R. Wheeler), and the phrase-named entity *H. sp. Kojonup* (C.M. Lewis 288), appear to be closely related and to form a natural group. These taxa share the following combination of characters: leaves ericoid (with strongly revolute margins meeting the midrib beneath); flowers pedicellate, with a single floral bract at the apex of the pedicel immediately below the flower; stamens arranged on one side of, and curving over, two densely pubescent carpels; staminodes present;  $\pm$  isodiametric leaf epidermal cells each with a minute, sharp, central process (giving the leaf lamina a minutely muriculate surface); obtuse to sub-acute leaf apices bearing a tuft of tiny hairs (usually visible only at high magnification on young leaves and sometimes reduced to one or two hairs or short papillae); and true leaf margins visible as a narrow, scarious, white strip of tissue adjacent to the midrib below, clearly visible in young leaves and usually so in mature leaves (the margin is very narrow and often obscure in older leaves of *H. papillata*).

No other ericoid-leaved taxa in Western Australia have the apical hair tuft, while in all but three (*H. ancistrophylla* J.R. Wheeler, *H. carinata* J.R. Wheeler and *H. stowardii* S. Moore) the margins are so tightly revolute that adaxial lamina tissue abuts the midrib and the true margin is hidden and ‘internal’ to the leaf. These three taxa all have pungent leaf apices, non-muriculate leaves and lack staminodes, and are probably not closely related to the *H. lineata* group. Wheeler (2004a), in an interim key to Western Australian species of *Hibbertia*, included *H. avonensis* J.R. Wheeler in a couplet that otherwise includes only members of the *H. lineata* group. This species also lacks the visible leaf margin, apical hair tuft and muriculate surface, and is not considered to belong in the group. Wheeler (2002) believed it to be close to *H. gracilipes* Benth. No eastern Australian species appear to be closely related to the group.

Horn (2005) provided a partial phylogeny of *Hibbertia* based on cpDNA and ITS sequences. Unfortunately, no members of the *H. lineata* species group are included in that phylogeny, so an assumption of close

relationship between these taxa is currently untested. Nevertheless, they are morphologically close and are regarded for the purpose of this paper to be closely related. The *H. lineata* species group may be related to the *H. hypericoides* (DC.) Benth. species group (Thiele & Cockerton 2015); these two groups share obtuse to subacute leaves with recurved margins, a pedicellate flower with the primary bract at the apex of the pedicel, and staminodes lateral to the stamen rows.

*Hibbertia recurvifolia* and *H. verrucosa* were described in the genus *Pleurandra* Labill., at a time when *Hibbertia* in the modern sense was divided into three or four genera on the basis of androecial arrangement (see e.g. de Candolle 1824). Taxa with stamens all on one side of the two carpels were placed in *Pleurandra* or *Hemistemma* Juss. ex Thouars (the latter recognised by some authors to accommodate species with staminodes); taxa with stamens arranged all around the 1–15 carpels were placed in *Candollea* Labill. or *Hibbertia sens. str.*, depending on whether the stamens were connate in bundles or free. Given that all members of the *H. lineata* group clearly have stamens on one side of the carpels, it is odd that Steudel described *H. lineata* and *H. microphylla* in *Hibbertia*. His protologues for these taxa make no mention of the androecium, and he may have overlooked this important feature (see also Thiele 2017). Several of Steudel's contributions to *Plantae Preissianae* were criticised as deficient by contemporaries and were revised in later parts of the same work (McGillivray 1975).

Several varieties of some taxa in the group were subsequently described by Bentham (1863). *Hibbertia lineata* var. *parviflora* Benth. is a nomenclatural synonym of *H. diamesogonos* (Steud.) J.R.Wheeler (Wheeler 2004b), while *H. recurvifolia* var. *virens* Benth. was erected for plants with slightly larger and greener leaves than the typical variety (see under *H. lineata* below for discussion).

*Hibbertia* sp. Kojonup (C.M. Lewis 288) was erected by J. Wheeler at the Western Australian Herbarium (PERTH) in 1998, to accommodate specimens from the western part of the range of the species group that were similar in leaf size and shape to *H. lineata* and *H. recurvifolia* but differed from those species in having moderately to densely pubescent rather than glabrous sepals, with mixed stellate and uncinat hairs. Assessment of specimens determined under this name at PERTH has uncovered several distinct entities, some of which are referable to existing species while others comprise new taxa. Taxonomic resolution of the entities in *H. sp. Kojonup* required an assessment of species boundaries throughout the group, leading to the present paper.

## Methods

Descriptions are based on all specimens held at PERTH. Vegetative features and sepals were measured dry; all other floral measurements were made after rehydration in boiling water with a little detergent. For morphometric analyses of leaves in *H. lineata*, *H. recurvifolia*, *H. microphylla* and *H. sp. Kojonup*, lengths of three well-developed, typical, mature leaves were measured to the nearest 0.5 mm. Degree of leaf apex recurvation was scored by eye using a qualitative scale of 0–5 (Figure 1 inset). Means for each specimen were calculated from the three measurements. The terms 'lateral' and 'behind', in reference to the position of staminodes relative to the rows of stamens, are used as in Thiele and Cockerton (2015).

Bioregions in distribution statements are based on IBRA7 (Department of the Environment 2013) and shown in grey on the distribution maps. The designation 'image!' in type citations indicates that I have viewed a high-resolution image of the specimen on Global Plants (<http://plants.jstor.org/>).

### Separation of *Hibbertia lineata* and *H. recurvifolia*

*Hibbertia lineata* and *H. recurvifolia* share very similar floral and indumentum characters, both having glabrous pedicels and outer sepals, the latter distinctively pale-margined and often with an unusually glistening surface when dry. Steudel (1845) described the former as having leaves 4–8 lines (c. 8–16 mm) long and with a shortly recurved apex, and the latter as having leaves 4 lines (c. 8 mm) long and with a distinctly recurved apex. These descriptions match the types. Wheeler (2004a), in an interim key to Western Australian species, used leaf length only to separate the taxa (leaves 8–25 mm long in *H. lineata* cf. 2.5–12 mm long in *H. recurvifolia*). The overlap of these ranges casts doubt on the discrimination of these two species.

The relationship between leaf length and apex recurvation for all specimens of *H. lineata* and *H. recurvifolia* at PERTH is shown in Figure 1, and mean leaf length mapped in Figure 2. In general, specimens determined as *H. recurvifolia* tend to have smaller leaves with slightly more strongly recurved apices and to occur in drier, more inland and eastern sites, while specimens determined as *H. lineata* tend to have longer leaves with slightly straighter apices and to occur in wetter, more south-western sites. However, there is substantial overlap, with most specimens falling in the broad overlap for leaf length (8–12 mm) given in Wheeler (2004a), no apparent clustering, and a clinal trend in distribution (Figure 2). In areas where both taxa are considered to occur (e.g. Stirling Range, Fitzgerald River National Park), no characters could be found to adequately separate them; field observations in the Stirling Range show that specimens attributable to each species co-occur and completely intergrade, with plants in sheltered, moister microhabitats (such as amongst other vegetation) having longer, straighter leaves and adjacent plants in exposed, drier sites having shorter, more recurved ones. Accordingly, *H. lineata* and *H. recurvifolia* are here combined, under *H. lineata*.

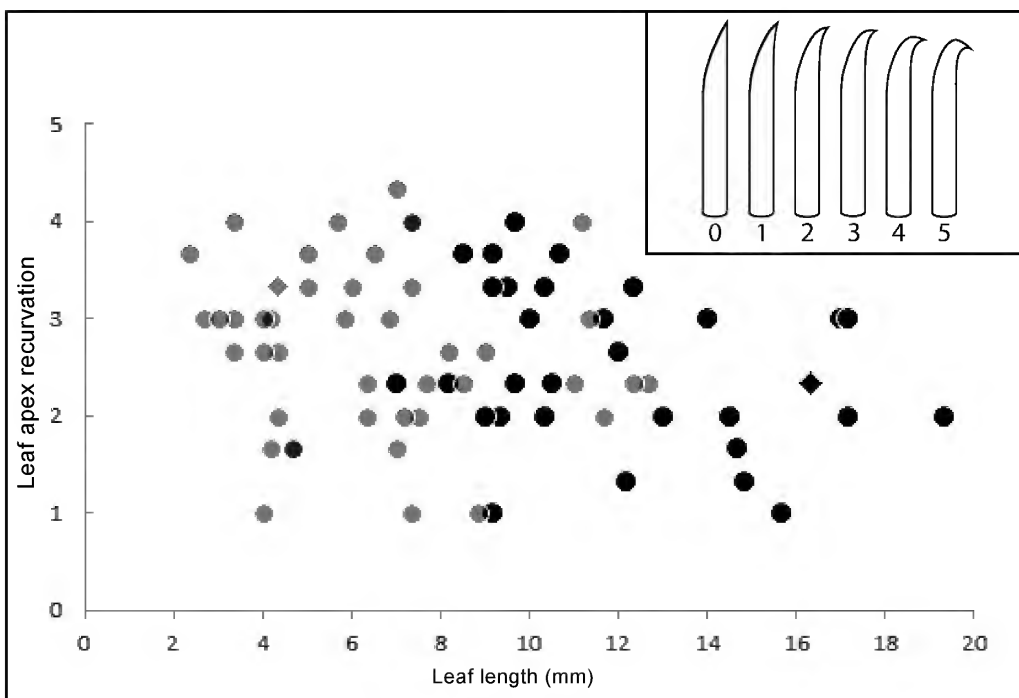


Figure 1. Leaf length and apex recurvation in *Hibbertia lineata* (black) and *H. recurvifolia* (grey). Circles are PERTH specimens; diamonds are type specimens (*H. lineata*: MEL 666865; *H. recurvifolia*: P00682341). Inset – leaf apex recurvation score guide.

### Separation of *Hibbertia* sp. Kojonup and *H. microphylla*

Herbarium assessment of the 27 PERTH specimens assigned to *H. sp. Kojonup* showed that they could be separated into several discrete entities. A number of specimens were clearly referable on the basis of characters discussed under the species treatments below to *H. lineata*, *H. verrucosa* and a newly recognised species, *H. depilipes* K.R.Thiele. Eight specimens, including the reference specimen for the phrase name (C.M. Lewis 288), remained following this reassignment. These were similar to *H. microphylla* in habit, flower size, and leaf, pedicel and sepal indumentum but had substantially longer leaves than is typical for that species. They also occurred to the west and south-west of the range of typical *H. microphylla*. In general, leaf lengths in *H. microphylla* show a clinal trend with increasing lengths to the west and south-west (Figure 3). On this basis, *H. sp. Kojonup* is considered here to be an informal synonym of *H. microphylla*.

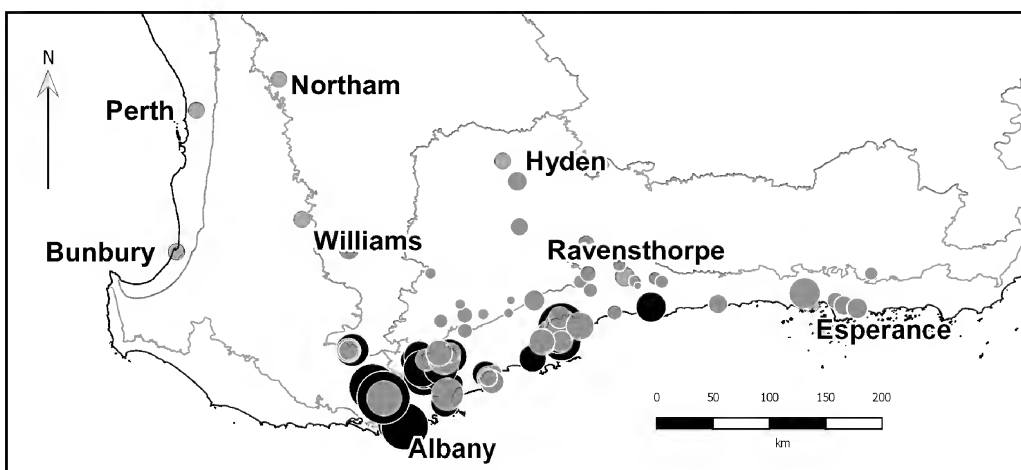


Figure 2. Geographic distribution of leaf lengths in *H. lineata* (black) and *H. recurvifolia* (grey). Symbol sizes are proportional to leaf length.

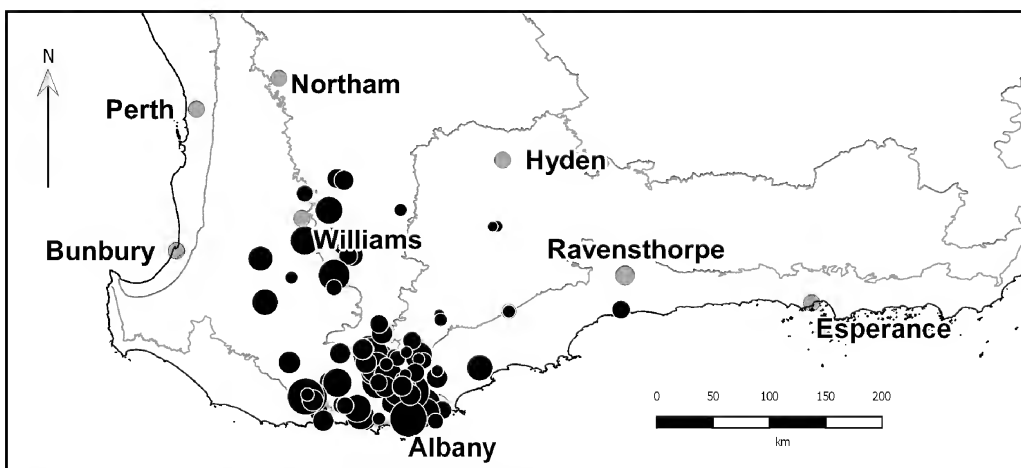


Figure 3. Geographic distribution of leaf lengths in *H. microphylla*. Symbol sizes are proportional to leaf length.

### Key to species of the *Hibbertia lineata* species group

1. Outer sepals and pedicels glabrous (except sometimes a minute ciliate fringe on the sepals); sepals prominently pale-margined (often glistening when dry) ..... **H. lineata**
- 1: Outer sepals moderately to densely pubescent usually with at least some hooked hairs, often also with stellate ones; pedicels glabrous or sparsely pubescent with stellate hairs; sepals not prominently pale-margined
  2. Young stems, abaxial surface of petioles, and pedicels glabrous ..... **H. depilipes**
  - 2: Young stems sparsely to moderately pubescent; abaxial surface of petioles moderately to densely and minutely stellate-hairy; pedicels sparsely to moderately stellate-hairy
    3. Leaves rounded in transverse section, usually distinctly tuberculate with evenly scattered tubercles bearing radially stellate hairs at least on young leaves; sepals with distinctly thickened midribs ..... **H. verrucosa**
    - 3: Leaves rounded or angled in transverse section ( $\pm$  flat-topped and with an angle at the apparent leaf margin), smooth or with a row of tubercles along the angle, these bearing forward-directed, simple or few-branched hairs when young; sepals with thickened bases but without distinctly thickened midribs
      4. Sepals lacking hooked hairs (sparsely and minutely stellate-hairy) ..... **H. papillata**
      - 4: Sepals with at least some hooked hairs
        5. Leaves (1.2–)2–4(–8) mm long, usually recurved and retrorse (occasionally longer, straighter and more spreading); usually weak plants often with slender stems ascending through other vegetation; sepals with short, hooked hairs usually restricted to or more common at the sepal bases ..... **H. microphylla**
        - 5: Leaves (5–)6–12 mm long, spreading,  $\pm$ straight except at the apex; erect plants with robust stems; sepals evenly covered with numerous hooked hairs throughout ..... **H. polyancistra**

### Taxonomy

#### ***Hibbertia depilipes* K.R.Thiele, *sp. nov.***

*Type:* Foley Road, Orchard Valley, 9.2 km from Scotts Brook Road, Western Australia, 26 October 2013, K.R. Thiele 4777 (*holo:* PERTH 08775230; *iso:* AD, CANB, K).

Usually sprawling (occasionally  $\pm$ erect) *shrubs* (10–)20–40 cm high, the stems when prostrate sometimes with adventitious roots; young branchlets glabrous to sparsely stellate-hairy (and then glabrescent). *Leaves* erect to widely spreading, scattered; petioles 0.2–0.6 mm long, abaxially glabrous (very rarely with a line of dense hairs at the junction with the stem, but otherwise glabrous), adaxially shortly hairy and subtending a tuft of short hairs; blades linear (very narrowly ovate when short), (4–)5–10(–13) mm long, 0.7–1(–1.5) mm wide, the margins strongly recurved and obscuring all but the midrib abaxially, the true margin of the leaf visible as parallel, whitish, scarious strips either side of the midrib; adaxial surface smooth or with a line of sharp tubercles along an angle on the apparent margin, glabrous or with scattered hooked and/or simple and forward-directed hairs on the marginal tubercles; abaxial surface (midrib) glabrous; apex an obtuse, thickened point terminated by a tuft of minute hairs or papillae, slightly to distinctly recurved. *Flowers* long-pedicellate, borne singly in upper leaf axils; pedicels (10–)15–25(–40) mm long, glabrous (rarely very sparsely stellate-hairy); *primary bract* at the apex of the pedicel immediately below the calyx, herbaceous, 1–2.5 mm long,

narrowly triangular, acute, minutely and sparsely stellate-hairy; *secondary bracts* 2–4,  $\pm$ surrounding the pedicel base, *c.* 1 mm long, as for the primary bract in shape and indumentum but brown and scarious. *Sepals* 5, ovate, 3.5–6 mm long, sparsely to moderately pubescent with spreading to retrorse hooked hairs underlain by sparse to dense, minute, stellate hairs (parts of the inner sepals overlain by outer sepals in bud lacking the hooked hairs and with denser and more prominent stellate hairs); midribs not prominent but the sepal bases  $\pm$ thickened; outer sepals acute; inner sepals similar in size and shape to the outer but slightly less acute. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, 4.5–7 mm long. *Stamens* 10 (rarely fewer by abortion), all on one side of the gynoeceum and curving over the carpels; filaments *c.* 0.5 mm long; anthers rectangular, 1.5–2 mm long, dehiscing by introrse, longitudinal slits; *staminodes* 2–3 either side of the stamens (occasionally with a few behind the stamens). *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, *c.* 1.5–2 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen. (Figure 4A)

*Diagnostic features.* *Hibbertia depilipes* may be uniquely diagnosed within the *H. lineata* species group by its glabrous abaxial petiole surfaces; it also has glabrous pedicels contrasting with the sparsely to moderately pubescent sepals.

*Other specimens examined.* WESTERNAUSTRALIA: 27 km NE of Denmark, 13 Nov. 1991, *A.R. Annels* 1932 (PERTH); 27 km NE of Denmark, 17 Dec. 1991, *A.R. Annels* 2096 (PERTH); 12 km WSW of Narrikup, 16 Nov. 1993, *A.R. Annels* 4165 (PERTH); Lake Unicup area, 13 Nov. 2000, *R.J. Cranfield* 16036 (PERTH); Collie, Feb. 1968, *L.W.J. Dodd s.n.* (PERTH); 5.4 km W of junction of Crouch and Jalbarragup Road, 17 Jan. 1997, *P. Ellery & T. Annels* B 54.8 (PERTH); Cobertup Nature Reserve, 10 Dec. 1997, *G.J. Keighery* 15192 (PERTH); Kululinup [Kulunilup] Nature Reserve, 26 Oct. 1997, *G.J. Keighery & N. Gibson* 2179 (PERTH); Mettabinup Nature Reserve, *c.* 29 km NE of Tonebridge, 20 Oct. 1999, *G.J. Keighery & N. Gibson* 5357 (PERTH); Mettabinup Nature Reserve, *c.* 29 km NE of Tonebridge, 20 Oct. 1999, *G.J. Keighery & N. Gibson* 5358 (PERTH); Kojonup, 29 Oct. 1997, *C.M. Lewis* 310 (PERTH); 33 km direct SSW of Kojonup, 10 Oct. 1999, *C.M. Lewis* 420 (PERTH); 35 km WSW (direct) of Kojonup, 10 Oct. 1998, *C.M. Lewis* 430 (PERTH); 35 km (direct) SW of Kojonup, 22 Oct. 1998, *C.M. Lewis* 445 (PERTH); Milyeannup, 5 Dec. 1984, *G.S. McCutcheon* 1117 (PERTH); *c.* 5 km E of Lake Unicup, 11 Dec. 1974, *R. Pullen* 9980 (PERTH).

*Phenology.* Flowering plants have been collected between mid-October and mid-December. One specimen (*L.W.J. Dodd s.n.*, PERTH 03097781) is labelled as flowering in ‘?Feb.’ and it is possible that in some seasons it may extend that long.



Figure 4. A – *Hibbertia depilipes* (K.R. Thiele 4777); B – *H. polyancistra* (K.R. Thiele 5139); C – *H. microphylla* (K.R. Thiele 4772); D – *H. lineata* (K.R. Thiele 5118).

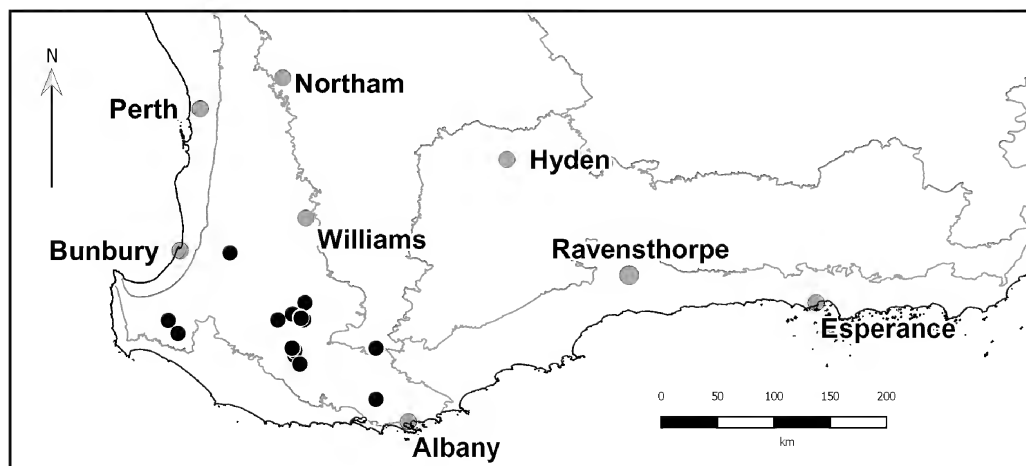


Figure 5. Distribution of *Hibbertia depilipes*.

**Distribution and habitat.** Widely distributed in the far south-west of Western Australia, mostly west of the Albany Highway and inland from the coast, in the Southern Jarrah Forest sub-bioregion with one specimen just across the boundary of the Avon Wheatbelt bioregion. Most specimens have been collected in an area from west of Kojonup south to near Lake Muir, with outliers at Collie, Nannup, Cranbrook and north-east of Denmark (Figure 5). It is the most westerly species in the group, and appears from current collections to be allopatric or narrowly sympatric with *H. microphylla* and *H. lineata*.

*Hibbertia depilipes* occurs in open woodland and forests dominated by *Corymbia calophylla*, *Eucalyptus wandoo*, *E. marginata* and *E. decipiens*, with open to shrubby understoreys, on slopes, flats and valley bottoms usually on or adjacent to rather moist sites, in sandy clay or clay soils over laterite. It differs in habitat from the related (and partially sympatric or allopatric) *H. lineata* and *H. microphylla*, both of which tend to occur in kwongan or mallee-heath in drier, more open sites on lighter, sandier soils.

**Conservation status.** *Hibbertia depilipes* is widespread, relatively common and not considered to be under threat.

**Etymology.** The epithet is from the Latin *depilis* (without hair) and *pes* (a foot), in reference to the glabrous petioles.

**Notes.** When well-grown *H. depilipes* is a sprawling shrub with stems producing adventitious roots where they contact the ground, and flowers held erect on long pedicels. This growth habit has not been observed in other members of the group. Young plants, or resprouts following fire, may be more erect.

Most specimens of *H. depilipes* were previously included in *H. sp.* Kojonup, but do not match the reference specimen for that phrase name (now referred to *H. microphylla*, see below) due to their distinctively glabrous petioles and pedicels. Others have been redetermined from *H. aff. recurvifolia* and *H. lineata*. It may be distinguished from typical *H. microphylla* by its longer, spreading rather than retrorse leaves and glabrous pedicels and petioles, and from *H. lineata* by its non-glabrous sepals.

A few specimens are slightly atypical. *A.R. Annels* 4165 from near Narrikup at the eastern end of the range of the species has virtually glabrous sepals, with a few uncinat hairs near the base. *G. Byrne* 4270 has

petioles that are glabrous except for a line of dense hairs along the junction with the stem. *G. Keighery* & *N. Gibson* 5358 has pedicels with few, tiny, widely scattered stellate hairs. All are typical in all other respects for *H. depilipes*, and do not break down the boundary between this and other species.

While the differences between *H. depilipes* and other members of the species group (the glabrous petioles and glabrous pedicel contrasting with pubescent sepals) may seem minor, they are (noting the few exceptions above) correlated and consistent, geographically distinct, and allow unambiguous determination of specimens. Petiole indumentum in the other taxa in the group (e.g. *H. microphylla*, *H. lineata*) shows no sign of becoming sparser in specimens collected close to the range of *H. depilipes*, indicating that the variation is not clinal in nature. *Hibbertia depilipes* occupies a different habitat from other taxa where they are allopatric or narrowly sympatric (woodland and forest cf. kwongan and heath), and there is no reason to regard these characters as expressions of these differing habitats. For these reasons, it is regarded here as a distinct species.

***Hibbertia lineata*** Steud., in Lehm. *Pl. Preiss.* 1(2): 272 (1845). *Type citation*: ‘In confragosis umbrosis sylvaticis ad latus septentrionale montis Wuljenup [Willyung Hill, near Albany], ditomis Plantagenet, 14 Oct. 1840. Herb. Preiss. No. 2151’ (*syn*: BR 13462529 image!, HBG 507144 image!, LD 1359557 image!, M 212899 image!, MEL 666865!, MEL 666866!, MEL 666867 (fragments)!, MO 279479 image!).

*Hibbertia recurvifolia* (Steud.) Benth., *Fl. Austral.* 1: 24 (1863); *Pleurandra recurvifolia* Steud., in Lehm. *Pl. Preiss.* 1(2): 264 (1845). *Type citation*: ‘In glareosis sterilibus ad radices collium Konkoberup [Mt Melville near Cape Riche], districtus Kent, 19. Nov. 1840. Herb. Preiss. No. 2170’ (*syn*: LD 1811633 image!, MEL 666666 (fragments)!).

*Hibbertia pullula* S.Moore, *J. Linn. Soc., Bot.* xlv. 162 (1920). *Type citation*: ‘Ongerup District; Stoward, 842, 843’ (*syn*: BM 915843 image!).

Spreading to erect *shrubs* (10–)30–60(–100) cm high, resprouting from a stout, woody rootstock after fire; young branchlets sparsely to moderately stellate-hairy when young, ±glabrescent. *Leaves* erect to spreading, scattered; petioles 0.2–0.5 mm long, abaxially and adaxially moderately to densely stellate-hairy (very rarely glabrous), subtending a tuft of short hairs; blades linear (very narrowly ovate when short), (2–)5–15(–20) mm long, 0.6–1.0 mm wide, the margins strongly recurved and obscuring all but the midrib abaxially, the true margin of the leaf visible as parallel, whitish, scarious strips either side of the midrib; adaxial surface smooth or with scattered tubercles when young, usually with a line of sharp tubercles along an angle on the apparent margin, glabrous or with scattered hooked and/or simple and forward-directed hairs on the tubercles; abaxial surface (midrib) glabrous; apex an obtuse, thickened point terminated by a tuft of minute hairs or papillae, slightly to distinctly recurved. *Flowers* pedicellate, borne singly in upper leaf axils; pedicels (2.5–)5–20 mm long, glabrous; *primary bract* at the apex of the pedicel immediately below the calyx, herbaceous, 2–4 mm long, narrowly ovate to narrowly triangular, acute, glabrous to minutely and sparsely stellate-hairy, fimbriolate; *secondary bracts* 0–4, brown, ±surrounding the base of the pedicel, c. 2–3 mm long, as for the primary bract in shape and indumentum but more scarious. *Sepals* 5, ovate, 5–6 mm long; outer sepals glabrous, often with a glistening, slightly crystalline surface appearance when dry, acute, the margins usually prominently pale and whitish (contrasting with the body) but not scarious, sometimes fimbriolate, the midribs not prominent but the sepal bases ±thickened; inner sepals sparsely to moderately minutely stellate-hairy where covered by the outer sepals in bud, similar in size and shape to the outer but broader and slightly less acute. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, 5.5–9 mm long. *Stamens* (8–)10(11), all on one side of the gynoecium and curving over the carpels;

filaments 0.5–0.8 mm long; anthers rectangular, 1.8–2.2 mm long, dehiscent by introrse, longitudinal slits; *staminodes* 2–3 either side of the stamens or to 12 and forming a line behind the stamens. *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, c. 1.5–2 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen. (Figure 4D)

*Diagnostic features.* *Hibbertia lineata* may be uniquely diagnosed within the *H. lineata* species group by its glabrous outer sepals and pedicels, and sepals that are usually whitish-margined.

*Selected specimens examined.* WESTERN AUSTRALIA: Dragon Rocks Nature Reserve, 23 Aug. 1991, *A.M. Coates* 2602 (PERTH); Narrikup, 15 Oct. 1999, *E. J. Croxford* 8215 (PERTH); 6 km N of Mount Manypeaks, 11 Dec. 1996, *R. Davis* 1785 (PERTH); Jerramungup, 17 Aug. 1988, *B. Dixon* 26/88 (PERTH); Wagin, 9 Oct. 1942, *C.A. Gardner* 6484 (PERTH); Mount Short, N of Ravensthorpe, 30 Aug. 1963, *A.S. George* 5704 (PERTH); 12 km NW of Cape Riche and 6 km SE of Wellstead, 20 Oct. 1991, *W. Greuter* 23036 (PERTH); N of Toolbrunup Peak, Stirling Range National Park, 22 Oct. 1971, *R.D. Hoogland* 12179 (PERTH); along Bremer Bay Road c. 43 miles from Albany, Green Range area, 16 Nov. 1974, *R.D. Hoogland & G.L. Stebbins* GLS 12541 (PERTH); S side of Springdale Road, 6.6 km W of its junction with Mason Bay Road, 25 Sep. 2001, *J.W. Horn* 4133 (PERTH); S side of Collets Road, 0.45 km W of Quaalup Homestead Road, Fitzgerald River National Park, 28 Sep. 1999, *J.W. Horn & R. Butcher* 2645 (PERTH); Fox Road 2.6 km S of Brockway Road, c. 16 km NNW of Esperance, 12 Oct. 2000, *G.J. Keighery & N. Gibson* 5077 (PERTH); Jerramungup, 14 Sep. 1994, *W.R. Lullfitz* 8 (PERTH); Jerramungup, 22 Aug. 1994, *W.R. Lullfitz* 60 (PERTH); 0.3 km along Kau Rock Road from Coolinup Road, 22 Sep. 1985, *L.J. Nunn* 219 (PERTH); c. 14 km E of the mouth of the Oldfield River, 12 Oct. 1969, *A.E. Orchard* 1498 (PERTH); South Stirling Road, 3.3 km N of Pfeiffer Road junction, 20 Oct. 1999, *E.M. Sandiford* 463 (PERTH); 12 km NNW of Ongerup, 15 Sep. 2004, *L. Strahan* 258 (PERTH); 73 km E of Jerramungup, 23 Sep. 1986, *J.R. Wheeler* 2430 (PERTH); West Mount Barren, 23 Sep. 1986, *J.R. Wheeler* 2431 (PERTH); c. 2 km W of track to West Mount Barren, Fitzgerald River National Park, 23 Sep. 1986, *J.R. Wheeler* 2439 (PERTH); lower slopes of Mount Melville, 24 Sep. 1986, *J.R. Wheeler* 2447 (PERTH); Collets Road at Mount Maxwell turnout, 1.6 km from Devils Creek Road, Fitzgerald River National Park, 6 Sep. 2001, *J.R. Wheeler* 4073 (PERTH).

*Phenology.* Flowers mainly from early September to mid-November, but occasionally from as early as late May. In general, inland and easterly populations flower earlier than more westerly and coastal ones.

*Distribution and habitat.* Occurs widely in the Esperance Plains, southern Avon Wheatbelt and Mallee, and south-eastern Jarrah Forest bioregions, from near Narrikup east to the Oldfield River, and in scattered localities inland to Wagin and Dragon Rocks Nature Reserve (Figure 6), usually not close to the coast, in kwongan and mallee-heath on sandplains and gentle slopes in light-textured soils over laterite, spongolite or granite.

*Conservation status.* *Hibbertia lineata* is widespread, common and not considered to be at risk.

*Notes.* Plants in drier locations inland and to the east of the range tend to have shorter leaves with more distinctly recurved apices; these were previously ascribed to *H. recurvifolia*. The type of *H. lineata* is a relatively long-leaved plant as described in the protologue, and has relatively straight leaf apices, while that of *Pleurandra recurvifolia* has shorter leaves with more distinctly recurved apices. *Hibbertia pullula* has shorter leaves still (both syntypes). All three fall within the range of variation accepted here for *H. lineata*. Both *H. lineata* and *H. recurvifolia* were described by Steudel in the same work; the name *H. lineata* is preferred as it was originally described under *Hibbertia*.

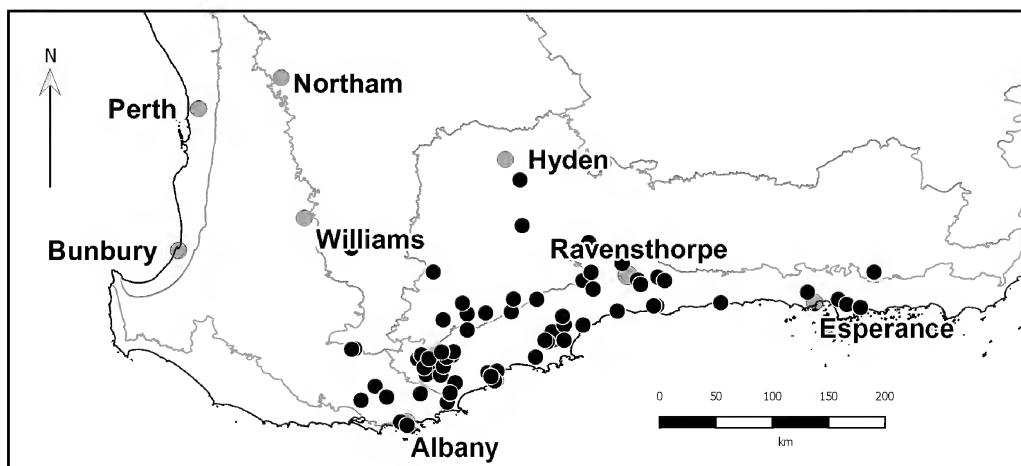


Figure 6. Distribution of *Hibbertia lineata*.

Two specimens from a population near Jerramungup (*W.R. Lullfitz* 8, *W.R. Lullfitz* 60) have very short leaves *c.* 2 mm long (as short as many specimens of *H. microphylla*), but the glabrous, pale-margined outer sepals (glistening when dry) of *H. lineata*. Sepal indumentum in this group appears to be a more reliable character than leaf length, which in all species is very variable depending on growth conditions.

Plants have a robust, woody rootstock and resprout abundantly after fire to form small, dense, compact shrubs. In long-unburnt areas they become taller and more openly-branched, with the elongate branches sometimes spreading widely.

In addition to the glabrous outer sepals that are diagnostic within the species group, *H. lineata* may be distinguished from *H. depilipes* by its densely stellate-hairy petioles (but see below), from *H. verrucosa* by its leaves which tend to be flat-topped with a distinct lateral angle bearing a row of tubercles with forward-directed hairs (rounded and with scattered tubercles bearing stellate hairs in *H. verrucosa*), and from *H. microphylla* by its generally longer, spreading-erect rather than retrorse leaves. The outer sepals of *H. lineata* almost always have distinctively pale margins differing in colour but not texture from the body of the sepal. In dried specimens there is also often a striking glistening appearance to the sepals when viewed under the strong light of a dissecting microscope, apparently caused by flattened, reflective cell walls; it is not known whether the cell structure differs from other taxa in the group, or whether the glistening is only apparent in this species because the sepals are glabrous.

In the field, *H. lineata* is superficially similar to *H. gracilipes*. The latter differs in having acute leaves without the small apical hair tuft, in lacking staminodes, and in having carpels that are glabrous except for an apical line of short hairs.

Two specimens, both from the western end of Fitzgerald River National Park near Mount Maxwell (*J.W. Horn & R. Butcher* 2645, *J.R. Wheeler* 4073), are unusual in having glabrous young stems and abaxial petiole surfaces, like *H. depilipes*. In all other respects including habit, habitat and floral characters they are typical for *H. lineata*. A further specimen (*J.W. Horn & R. Butcher* 2642) collected at the same location as *J.W. Horn & R. Butcher* 2645 has small, dense patches of hairs on an otherwise glabrous petiole on most leaves, and is thus intermediate with typical *H. lineata*. Field work is required to assess the significance of these specimens.

***Hibbertia microphylla*** Steud., in Lehm. *Pl. Preiss.* 1(2): 273 (1845). *Type citation*: ‘In glareosis prope montem Wuljenup districtus Plantagenet, Nov. 1840. Herb. Preiss. No. 2154 et 2180’ (*syn*: *Preiss* 2154: BR 13462505 image!, HBG 507143 image!, LD 1359437 image!, M 212897 image!, MEL 666868!, MEL 666869!, MEL 666870!, MO 279478 image!, P 682333 image!, P 682336 image!, S 8-20151 image!; *Preiss* 2180: LD 1359497 image!, P 682335 image!).

*Hemistemma revolutum* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 22(2): 4 (1849). *Type citation*: ‘Drumm. coll. III. n. 1’ (*holo*: KW 1000424 image!; *iso*: MEL 2227664 image!).

*Hibbertia lepidophylla* F.Muell., *Fragm.* 1(10): 217 (1859). *Type citation*: ‘In collibus glareosis ad Kojonurup [Kojaneerup] Australiae occidentalis. Mx.’ (*holo*: MEL 2283221!).

*Hibbertia* sp. Kojonup (C.M. Lewis 288), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 31 October 2014].

Low *shrubs* (10–)20–50 cm high, often with elongate, weakly ascending stems but sometimes compact and spreading, resprouting from the rootstock after fire; young branchlets sparsely to moderately stellate-hairy, glabrescent. *Leaves* retrorse to spreading, scattered; petioles 0.1–0.4 mm long, sparsely stellate-hairy abaxially and adaxially and subtending a tuft of short hairs; blades broadly ovate to elliptic or obovate, sometimes almost circular, rarely  $\pm$ linear, (1.2–)2–4(–8) mm long, 1–1.8 mm wide, the margins strongly recurved and obscuring all but the midrib abaxially, the true margin of the leaf visible as parallel, whitish, scarious strips either side of the midrib; adaxial surface smooth or (especially when young) with a line of sharp tubercles along an angle on the apparent margin (the tubercles sometimes more widespread and scattered), glabrous or with scattered hooked and/or simple and forward-directed hairs on the tubercles; abaxial surface (midrib) glabrous; apex an obtuse, thickened point terminated (at least in young leaves) by a tuft of minute hairs or papillae, distinctly recurved. *Flowers* pedicellate, borne singly in upper leaf axils; pedicels 5–15(–30) mm long, moderately to sparsely and minutely stellate-hairy; *primary bract* at the apex of the pedicel immediately below the calyx, herbaceous, 0.5–1.5 mm long, narrowly triangular to linear, acute, minutely stellate-hairy; *secondary bracts* 2–4,  $\pm$ surrounding the base of the pedicel, 1–2 mm long, as for the primary bract in shape and indumentum but often more scarious. *Sepals* 5, ovate, 3.5–5(–6) mm long, sparsely pubescent with spreading to retrorse, hooked hairs c. 0.1–0.2 mm long overtopping stellate hairs (the hooked hairs sometimes absent), the indumentum more dense at the sepal bases; midribs often prominent near the  $\pm$ thickened sepal bases but not continuing to the apex; outer sepals acute; inner sepals similar in size and shape to the outer but slightly less acute. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, 5.5–7.5 mm long. *Stamens* (9–)10(–15), all on one side of the gynoecium and curving over the carpels; filaments 0.5–1 mm long; anthers rectangular, 1.2–1.8 mm long, dehiscent by introrse, longitudinal slits; *staminodes* 4–9, lateral to and often also behind the stamens. *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, c. 1.2–1.6 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen. (Figure 4C)

*Diagnostic features.* *Hibbertia microphylla* may usually be uniquely diagnosed within the *H. lineata* species group by its very short (2–4 mm long) leaves which are retrorse on the straggling stems. Specimens with longer leaves may be discriminated by their stellate-hairy pedicels and sepals with uncinat hairs denser towards the base.

*Selected specimens examined.* WESTERN AUSTRALIA: Watershed Road, 5.5 km from Biro Road, 19.5 km ESE of Rocky Gully, 24 Nov. 1993, *A.R. Annels* ARA 4378 B (PERTH); Mount Many Peaks, 30 Oct. 1971, *A.M. Ashby* 4367 (PERTH); corner Lake Grace/Newdegate Station, Burngup Road, 12 Sep.

2003, *E. Bishop* 195 (PERTH); South Coast Highway, on SE side of Hay River crossing, 28 Nov. 1990, *N. Gibson & M. Lyons* 864 (PERTH); along Millenup Road (S of Porongurup Range) near Chester Pass Road, 20 Oct. 1971, *R.D. Hoogland* 12160 (PERTH); Great Southern Highway, c. 1.1 km S of junction with Gnowangerup-Tambellup Road in Tambellup, 1 Oct. 1999, *J.W. Horn & R. Butcher* 2712 (PERTH); Lupton Conservation Park, Brookton, 10 Aug. 2005, *F. Hort* 2548 (PERTH); East Mount Barren, S of Ravensthorpe, Sep. 1924, *A. Johnston s.n.* (PERTH); Boyup Brook Road, 12 km W of Kojonup, 12 Oct. 1998, *C.M. Lewis* 368 (PERTH); 2 km SSE of Mount Lindesay, 20 Aug. 1997, *K.A. Redwood* 043 (PERTH); Dryandra State Forest, 3 Dec. 1987, *D.M. Rose* 560 (PERTH); 21 km W of Newdegate, 26 Sep. 1983, *J. Taylor & P. Ollerenshaw* JT 2279 (PERTH); North Bannister, 20 Oct. 2008, *G. Turner* 407 (PERTH); Red Gum Pass c. 1 km N of Red Gum Springs, Stirling Range, 30 Sep. 1986, *J.R. Wheeler* 2501 (PERTH).

**Phenology.** Flowers mostly from mid-September to early December, occasionally as early as August.

**Distribution and habitat.** Widely distributed in the Avon Wheatbelt, eastern part of the Jarrah Forest, far eastern part of the Warren, and western end of the Esperance Plains and Mallee bioregions, as far north as near Brookton and with outliers near Newdegate and Ravensthorpe (Figure 7). Occurs in kwongan and mallee-heath, and in woodland and forest dominated by *Corymbia calophylla*, *Eucalyptus wandoo* and *E. marginata* often in or adjacent to small kwongan patches on laterite, in sandy, clay or clay-loam soils, sometimes in winter-wet areas.

**Conservation status.** *Hibbertia microphylla* is common and widespread and is not considered to be at risk.

**Notes.** Steudel (1845) cites two syntypes (*L. Preiss* 2154 & 2180) but gives a locality only for the second in the protologue. LD 1359437 (*L. Preiss* 2154) bears a label with the locality “In solo torfoso-arenoso prope urbiculam ‘Albany’ (Plantagenet)”.

Typical *H. microphylla* are very small-leaved plants (leaves 1–4 mm long) with the leaves distinctively retrorse on the stems. In general, plants from drier sites have shorter leaves. Two specimens (*J. Taylor & P. Ollerenshaw* JT 2279, *E. Bishop* 195) from an outlying population near Newdegate (the lowest rainfall within the range) have very small (c. 1 mm long), almost globular leaves. These match the type of *H. lepidophylla* F.Muell. from Kojaneerup (at higher but still relatively low rainfall). Longer-leaved

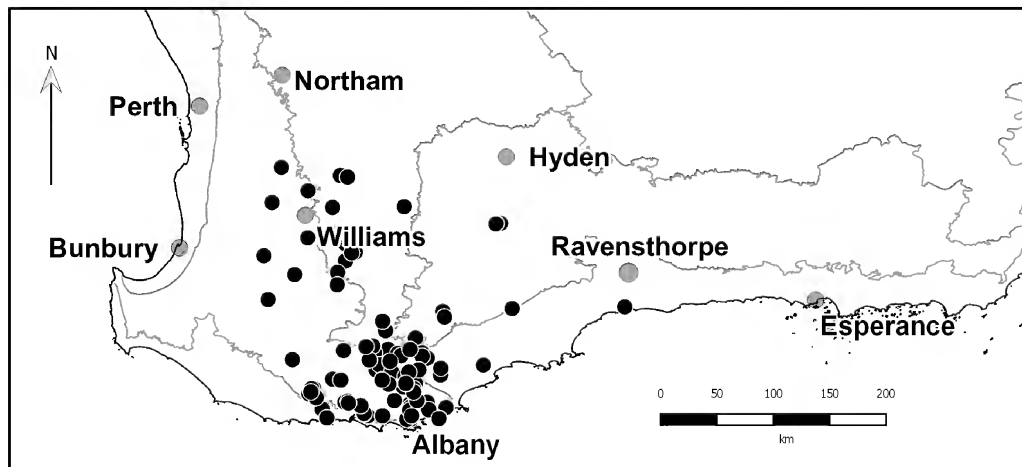


Figure 7. Distribution of *Hibbertia microphylla*.

plants, with leaves to 8 mm long, occur in the western and south-western parts of the range. These superficially approach *H. lineata* and *H. depilipes* in overall appearance. They may be discriminated from the former by the hairy sepals and from the latter by the hairy petioles and pedicels.

A specimen from North Bannister (*G. Turner* 407) is anomalous in having strongly scattered-verrucose leaves and sepals with a very dense indumentum of mixed uncinata and stellate hairs.

***Hibbertia papillata*** J.R. Wheeler, *Nuytsia* 15(2): 304–305 (2004). *Type*: Fitzgerald River National Park, south-east slopes of East Mt Barren, Western Australia, 23 September 1986, *J.R. Wheeler* 2428 (*holo*: PERTH 03034275!; *iso*: AD 181982!, CANB 591931!, K 700360 image!, MEL 2283113!, NSW 536974!).

Erect *shrubs* 30–40 cm high; young branchlets sparsely to moderately and minutely stellate-hairy, glabrescent. *Leaves* erect to spreading, rather crowded; petioles 0.5–1 mm long, abaxially and adaxially stellate-hairy; blades linear, 6–12 mm long, c. 1 mm wide, the margins strongly recurved and obscuring all but the midrib abaxially; adaxial surface non-tuberculate, papillate at high magnification, glabrous; abaxial surface (midrib) glabrous; apex an obtuse, thickened, slightly recurved point terminated in young leaves by a few short hairs or papillae. *Flowers* pedicellate, borne singly in upper leaf axils; pedicels 3–8 mm long, sparsely and minutely stellate-hairy; *primary bract* at the apex of the pedicel immediately below the calyx, herbaceous, 1.5–4 mm long, narrowly triangular, acute, minutely stellate-hairy; *secondary bracts* 2–4,  $\pm$ surrounding the base of the pedicel, 1–3 mm long, as for the primary bract in shape and indumentum but scarious. *Sepals* 5, ovate, 3.5–6 mm long, sparsely to moderately pubescent with minute, stellate hairs; midribs not prominent but the sepal bases  $\pm$ thickened; outer sepals acute; inner sepals similar in size and shape to the outer but slightly less acute. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, 4–7.5 mm long. *Stamens* (8–)10, all on one side of the gynoecium and curving over the carpels; filaments c. 0.5–1.5 mm long; anthers rectangular, 1–1.5 mm long, dehiscent by introrse, longitudinal slits; *staminodes* 2–4 either side of the stamens (occasionally with a few behind the stamens). *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, c. 1.5–2 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen.

*Diagnostic features.* *Hibbertia papillata* may be uniquely diagnosed within the *H. lineata* species group by the combination of  $\pm$ crowded, non-tuberculate, glabrous leaves and sepals with minute, stellate hairs only; the leaf surface is more coarsely papillate or muricate than in other members of the group.

*Other specimens examined.* WESTERN AUSTRALIA [localities withheld for conservation reasons]: 2 Nov. 1965, *A.S. George* 7262 (PERTH); 7 Oct. 1971, *R.D. Hoogland* 12079 (PERTH); 29 Sep. 1999, *J.W. Horn & R. Butcher* 2676 (PERTH); 1 Oct. 1970, *B.R. Maslin* 905 A (PERTH); 3 Sep. 1986, *K. Newbey* 1110 (PERTH); 22 Sep. 1986, *J.R. Wheeler* 2426 (PERTH); 8 Sep. 2001, *J.R. Wheeler* 4099 (PERTH); 4 Oct. 1966, *P.G. Wilson* 5447 (PERTH); 4 Oct. 1966, *P.G. Wilson* 5469 (PERTH).

*Phenology.* Flowers in September and October.

*Distribution and habitat.* *Hibbertia papillata* is narrowly endemic in Fitzgerald River National Park, occurring in the immediate vicinity of East Mount Barren with an inland outlier in the Eyre Range c. 8 km to the north-west (Figure 8). It grows in kwongan in shallow soils over quartzite, on rocky terraces and lower hillslopes.

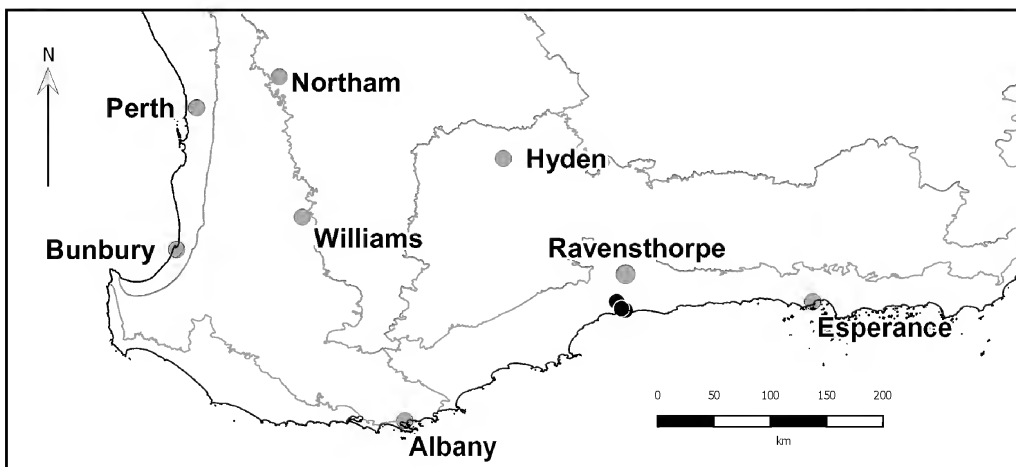


Figure 8. Distribution of *Hibbertia papillata*.

**Conservation status.** *Hibbertia papillata* is listed by Smith (2017) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, on account of its narrow range within Fitzgerald River National Park.

**Notes.** *Hibbertia papillata* differs from other species in the *H. lineata* species group in having the leaf margins so strongly recurved that the true margin is not visible, except in the youngest of leaves and sometimes towards the leaf apex of older leaves. It is considered to be a member of the group on the basis of its staminodes, leaf apex and muricate leaves; this latter feature is particularly well-developed in *H. papillata* (providing the etymology for the name). Its leaves, as in all species in the group, have more or less isodiametric epidermal cells, each cell with a single, blunt to sharp papilla at its centre. In other taxa in the group the cells and their papillae are smaller and less obvious.

***Hibbertia polyancistra* K.R.Thiele, *sp. nov.***

**Type:** [south-east of Karragullen] Western Australia [precise locality withheld for conservation reasons], 26 October 2014, K.R. Thiele 5139 (*holo*: PERTH 08775222; *iso*: AD, CANB).

Erect *shrubs* 30–45(–60) cm high, resprouting from a stout, woody rootstock after fire; young branchlets sparsely to moderately stellate-hairy, ±glabrescent. *Leaves* spreading, scattered; petioles 0.2–0.7 mm long, abaxially densely and minutely pubescent with stellate hairs, adaxially shortly pubescent and subtending a tuft of short hairs; blades linear (narrowly ovate when short), (5–)6–12 mm long, 1.8–2.5 mm wide, the margins strongly recurved and obscuring all but the midrib abaxially, the true margin of the leaf visible as parallel, whitish, scarious strips either side of the midrib; adaxial surface smooth or sparsely blunt-tuberculate, the tubercles usually concentrated on the rounded shoulders of the apparent margin, glabrous (young leaves sometimes with very sparse, hooked hairs); abaxial surface (midrib) glabrous; apex an obtuse, thickened point which in very young leaves is terminated by a few minute hairs or papillae, slightly (rarely distinctly) recurved. *Flowers* long-pedicellate, borne singly in upper leaf axils; pedicels (10–)12–25 mm long, moderately stellate-hairy; *primary bract* at the apex of the pedicel immediately below the calyx, narrowly triangular, obtuse, minutely stellate-hairy, 2–3 mm long; *secondary bracts* 2–4, ±surrounding the base of the pedicel, 2–3 mm long, as for the primary bract in shape and indumentum but more scarious. *Sepals* 5, ovate, (6–)7–8(–9) mm long, pubescent with moderately dense, evenly spaced, spreading to retrorse, hooked hairs 0.2–0.4 mm long underlain

by sparse to moderate, minute, stellate hairs, the hooked hairs borne on minute tubercles that are often purple at least when dry; midribs not prominent but the sepal bases distinctly thickened; outer sepals acute to slightly acuminate; inner sepals similar in size and shape to the outer. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, (5.5–)8–9 mm long. *Stamens* 10 (rarely fewer by abortion), all on one side of the gynoecium and curving over the carpels; filaments 0.5–1.0 mm long; anthers rectangular, 1.6–2.5 mm long, dehiscing by introrse, longitudinal slits; *staminodes* 2 or 3 either side of the stamens, sometimes with more forming a row behind the stamens. *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, c. 1.5–2 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen. (Figure 4B)

*Diagnostic features.* *Hibbertia polyancistra* may be uniquely diagnosed within the *H. lineata* species group by the combination of ±erect habit and large flowers (sepals (6–)7–8(–9) mm long) with the sepals thickly and evenly beset with hooked hairs.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons]: 13 Nov. 2000, *F. Hort* 1233 (PERTH); 27 Nov. 2000, *F. Hort* 1234 (PERTH); 30 Nov. 2000, *F. Hort* 1235 (PERTH); 30 Nov. 2000, *F. Hort* 1236 (PERTH); 18 Jan. 2001, *F. Hort* 1269 (PERTH); 1 Dec. 2003, *F. Hort* 2134 (PERTH); 30 Dec. 2005, *F. Hort* & *J. Hort* 2755 (PERTH).

*Phenology.* Collected flowering in November and December.

*Distribution and habitat.* Occurs in a restricted area of the Jarrah Forest bioregion in state forests south of the Brookton Highway east of Armadale (Figure 9), in kwongan patches on shallow soil over granite within a matrix of *Corymbia calophylla*-*Eucalyptus marginata* forest. Known populations are spread over an area of approximately 25 × 5 km.

*Conservation status.* To be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (M. Smith pers. comm.).

*Etymology.* The epithet is from the Greek *poly-* (many-), and *ankistron* (a fishhook), in reference to the numerous uncinat (hooked) hairs evenly covering the outer sepals.

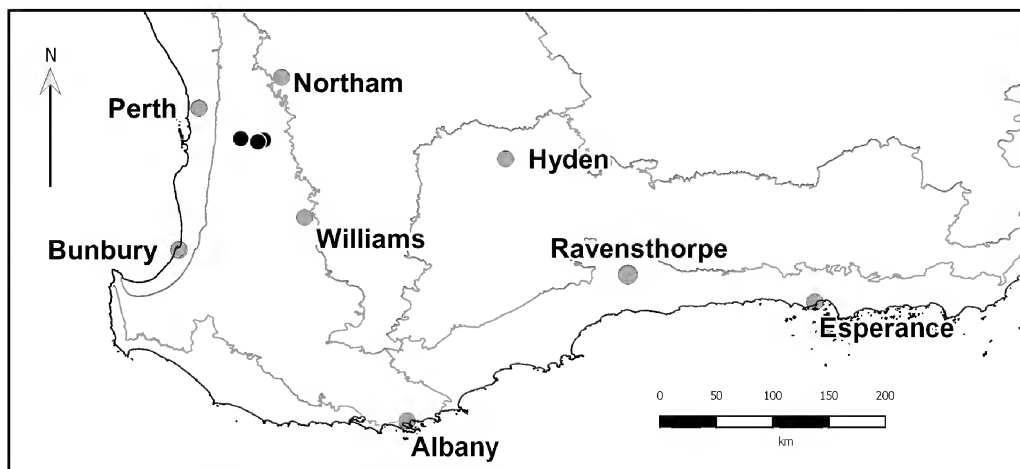


Figure 9. Distribution of *Hibbertia polyancistra*.

*Notes.* Morphologically and in habitat, *H. polyancistra* appears most similar to *H. microphylla*, the northernmost collections of which (e.g. *F. Hort* 2548, Lupton Conservation Park near Brookton) grow close to populations of *H. polyancistra* and have longer leaves than is typical for the species. It may be readily separated by its larger flowers (sepals (6–)7–8(–9) mm long *cf.* 3.5–5(–6) mm in *H. microphylla*) and sepal indumentum. In both species the outer sepals bear retrorse, uncinat hairs over minute stellate ones; in *H. polyancistra* the uncinat hairs are evenly dispersed on the sepals, while in *H. microphylla* they are more concentrated towards the sepal bases. *Hibbertia polyancistra* tends to be an upright shrub with spreading to erect leaves, while *H. microphylla* is usually more diffuse, with rather weak branches often supported by other vegetation and bearing spreading to retrorse leaves.

***Hibbertia verrucosa*** (Turcz.) Benth., *Fl. Austral.* 1: 22 (1863); *Pleurandra verrucosa* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 25 (2): 139 (1852). *Type citation*: ‘Nova Hollandia. Drum. coll. V. n. 289’ (*holo*: KW 1000419 image!; *iso*: K 687451 image!, MEL 35978!, P 682347 image!, PERTH 06797857!).

*Hibbertia virens* (Benth.) Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přir.* 2: 68 (1923); *Hibbertia recurvifolia* (Steud.) Benth. var. *virens* Benth., *Fl. Austral.* 1: 24 (1863). *Type citation*: ‘Point Henry, Oldfield’ (*syn*: MEL 666667!).

*Hibbertia* sp. Fitzgerald River (D.A. Rathbone 622), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 31 October 2014].

Erect *shrubs* 20–40(–70) cm high, resprouting from a stout, woody rootstock after fire; young branchlets moderately to densely stellate-hairy. *Leaves* spreading, scattered; petioles 0.2–0.5 mm long, densely stellate-hairy; blades narrowly rectangular to linear, (6–)8–12(–14) mm long, (0.8–)1–2 mm wide, the margins strongly recurved and obscuring all but the midrib abaxially, the true margin of the leaf usually visible as parallel, whitish, scarious strips either side of the midrib; adaxial surface with scattered, rounded tubercles each usually bearing a coarse, stellate hair at least when young (occasionally with few-branched, forward-directed hairs, or the leaves almost smooth), sometimes also with scattered, simple or hooked hairs between the tubercles when young; abaxial surface (midrib) when visible coarsely stellate-hairy; apex an obtuse, thickened point terminated when young by a tuft of minute hairs or papillae, slightly to moderately recurved. *Flowers* pedicellate, borne singly in upper leaf axils; pedicels 2–6 mm long, stellate-hairy; *primary bract* at the apex of the pedicel immediately below the calyx, herbaceous, 2–3 mm long, narrowly triangular, acute, stellate-hairy; *secondary bracts* 2–4 at the base of the pedicel, 2–3 mm long, as for the primary bract in shape and indumentum but scarious. *Sepals* 5, ovate, 5–6 mm long, moderately to densely pubescent with coarse, tubercle-based stellate hairs usually mixed with short, often retrorse, uncinat hairs; midribs at least on the outer sepals thick and prominent from the prominently thickened sepal bases to the apex; outer sepals acute; inner sepals similar in size and shape to the outer but slightly less acute. *Petals* 5, yellow, broadly obovate, broadly and shallowly emarginate, 7–9 mm long. *Stamens* (8–)10(–11), all on one side of the gynoecium and curving over the carpels; filaments *c.* 0.5 mm long; anthers rectangular, 1.6–2 mm long, dehiscing by introrse, longitudinal slits; *staminodes* present, 3–5 either side of the stamens, sometimes also with several behind the stamens. *Carpels* 2, compressed-globular, densely pubescent; styles excentrically inserted below the carpel apex, erect and curved away from the stamens, *c.* 1.5–2 mm long. *Ovules* 2 per carpel. *Fruiting carpels* and seeds not seen.

*Diagnostic features.* *Hibbertia verrucosa* may be uniquely diagnosed within the *H. lineata* species group by the combination of leaves with scattered tubercles each usually bearing a coarse, stellate hair at least when young, and sepals with a distinctly thickened midrib to the apex.

*Selected specimens.* WESTERN AUSTRALIA: Quoin Head, 25 Sep. 1970, *K.M. Allan* 510 (PERTH); Thumb Peak, Barren Range, 17 Oct. 1995, *S. Barrett* 542 (PERTH); 20 miles [32 km] N of Lake Bidy, 19 Nov. 1931, *W.E. Blackall* 1374 (PERTH); Bendering (east), Nature Reserve 18 km E of Bendering, 4 Sep. 1984, *J.M. Brown* 76 (PERTH); Twertup, Fitzgerald River National Park, 19 Aug. 1995, *G.F. Craig* 3345 (PERTH); Whoogarup Range, 2 Dec. 1960, *A.S. George* 1956 (PERTH); Fitzgerald River National Park, 1–2 km N of Quaalup homestead, 19 Oct. 1991, *W. Greuter* 22973 (PERTH); 16 km S of Condingup on E side of Duke of Orleans Bay Road, 19 Aug. 2006, *M. Hoggart* 7/0806 (PERTH); 2 km S of Thumb Peak, 8 Oct. 1975, *K.R. Newbey* 4844 (PERTH); 6 km NE of Boyatup Hill, 11 Oct. 1983, *K.R. Newbey* 9793 (PERTH); far south-western ridge of Mid[dle] Mount Barren, Fitzgerald River National Park State, 25 Sep. 2011, *D.A. Rathbone* 622 (PERTH); 4.8 km west of junction of Telegraph and Drummond tracks, Fitzgerald River National Park, 21 Nov. 2012, *D.A. Rathbone* 626 (PERTH); Fitzgerald River Reserve, 13 July 1970, *R.D. Royce* 8953 (PERTH); Archer Drive, 3/4 way to Lookout, Ravensthorpe Range, 30 June 1998, *E. Tink* 214 (PERTH); 32 km E of Newdegate, on Tarco Road near turnoff to Lake Varley, 21 Sep. 1986, *J.R. Wheeler* 2412 (PERTH); Pabelup Drive, 14 km NW of Point Ann turnoff, Fitzgerald River National Park, 8 Sep. 2001, *J.R. Wheeler* 4097 (PERTH); West Point Road, 13.3 km N of South Coast Highway, 25 Sep. 2001, *J.R. Wheeler* 4111 (PERTH); Parmango Road, 1 km N of Howick Road, Beaumont, 16 Oct. 1984, *S. Wheeler* 9 (PERTH); Ravensthorpe Range, 27 Sep. 1968, *P.G. Wilson* 7988 (PERTH).

*Phenology.* Flowers mostly between mid-August and mid-November, occasionally as early as July or as late as December.

*Distribution and habitat.* *Hibbertia verrucosa* is widespread in the Esperance Plains bioregion between Two Peoples Bay and Cape Arid, with scattered occurrences in adjacent parts of the Mallee bioregion in the vicinity of Newdegate and Lake Bidy and the Avon Wheatbelt bioregion near Bendering (Figure 10). It is common in Fitzgerald River National Park. Occurs in kwongan and mallee-heath, on sandplains and hillslopes in sandy soils over granite, quartzite and spongolite.

*Conservation status.* *Hibbertia verrucosa* is common, widespread and not considered to be at risk.

*Notes.* Two specimens (*D.A. Rathbone* 622, *D.A. Rathbone* 626), both from the vicinity of Middle Mount Barren in Fitzgerald River National Park, bear a remarkable indumentum on the sepals. The tubercles that bear the stellate hairs in these specimens are elongated, dark purplish and robustly bristle-like to 1 mm long, bearing the stellate hair at the apex and giving the sepals a very distinctive appearance unique in the genus. Tubercles on the leaves in these specimens are also slightly elongate (but not bristle-like). These two specimens were segregated at PERTH in 2014 under the phrase-name *H. sp.* Fitzgerald River (*D.A. Rathbone* 622). The type (*Drummond* V: 289) matches these two specimens, having the same bristle-like tubercles on the sepals. Drummond collected from the vicinity of Middle Mount Barren in late 1848 (George 2009).

Elsewhere within the range of the species the sepals have abundant tubercle-based stellate hairs, but the tubercles are rounded and not elongate. All these specimens are regarded here as belonging to the same species, with the Middle Mount Barren plants merely representing a florid over-development of the tubercles. If future field work at Middle Mount Barren indicates that they represent a distinct taxon, then this would be the true *H. verrucosa*, requiring a new name for all other material. Note that a number of specimens collected from Thumb Peak (e.g. *S. Barrett* 542, *K.R. Newbey* 4844), less than 10 km east of Middle Mount Barren and part of the same range, have sepal indumentum more usual for the species, lacking the elongate bristles (although their leaves are abundantly and robustly tuberculate, and the stellate hairs on the sepals arise from particularly robust tubercles).

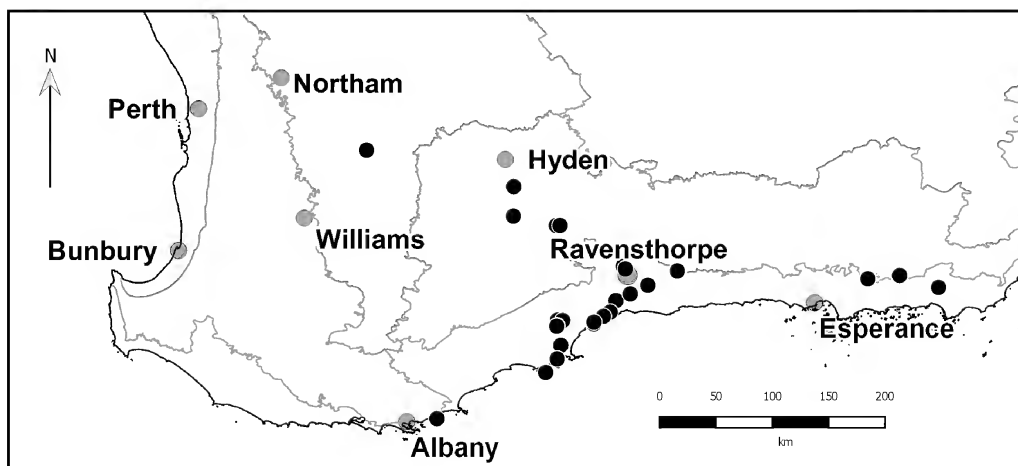


Figure 10. Distribution of *Hibbertia verrucosa*.

The syntype at K appears to be a mixed collection. It comprises two specimens, both mounted beneath a gummed label with an ink inscription ‘289 Swan River to Cape Riche (5<sup>th</sup> coll<sup>n</sup>) Drummond’ and with, in a different hand, a pencil annotation ‘?Pleurandra (*Hibbertia trachyphylla* Steud. [illegible]?)’. The pencil annotation is in error, *H. trachyphylla* (based on Preiss 2132) being a probable synonym of *H. hypericoides*. The two specimens are clearly different gatherings, though both are referable to *H. verrucosa*. The right-hand specimen matches the other syntypes, while the left-hand specimen has longer leaves and a sepal indumentum without the elongate tubercles. It is possible that Drummond collected both during the same expedition and placed them under the same collecting number.

### Acknowledgements

I thank Catherine Gallagher, Pina Milne and David Cantrill for assistance with MEL types, Sarah Barrett and Damien Rathbone for discussions and assistance with gathering material of *H. verrucosa* at Middle Mount Barren and Thumb Peak, Juliet Wege for nomenclatural advice, and Fred and Jean Hort for assistance with collections of *H. polyancistrata*.

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## Neotypification and redescription of *Amanita preissii* (Basidiomycota), and reconsideration of the status of *A. griseibrunnea*

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### Abstract

Davison, E.M., Guistiniano, D., McGurk, L.E., Watkin, E.L.J. & Bougher, N.L. Neotypification and redescription of *Amanita preissii* (Basidiomycota), and reconsideration of the status of *A. griseibrunnea*. *Nuytsia* 28:193–204. *Amanita preissii* (Fr.) Sacc. is redescribed. Re-examination of collections of *A. griseibrunnea* O.K.Mill. show that they do not differ significantly from *A. preissii* and the two species are combined. This species is common in the Perth IBRA subregion. Sequence data from the nuclear ribosomal internal transcribed spacer (ITS) region, 28S nuclear ribosomal large subunit rRNA (28S) region, RNA polymerase II (RPB2) region,  $\beta$ -tubulin region and translation elongation factor 1- $\alpha$  (EF1- $\alpha$ ) region have been deposited in GenBank.

### Introduction

Amanitas are some of the most common and conspicuous mushrooms in the south-west of Western Australia, but their ephemeral fruiting and lack of clearly defined macroscopic characters mean that their taxonomy is poorly understood. Characterisation of the large number of local species has been assisted by the use of DNA sequences, together with detailed microscopic examination. As local interest in macrofungi has been sporadic, there has been little continuity of mycological knowledge in Western Australia and there is often uncertainty about the identity of described species.

*Amanita preissii* (Fr.) Sacc. is one of the first mushrooms described from the south-west of Western Australia. It was collected by Ludwig Preiss between 1839 and 1841 (*Preiss* 2665) and sent to Elias Fries for naming (Hilton 1982). The majority of Preiss' cryptogams were lodged at the Berlin Herbarium but were destroyed when it was burnt down following an air raid in the Second World War (Hilton 1982, 1988). No duplicate of *Preiss* 2665 is known. Fries' description, as translated by Gentilli (1953), is brief:

'*Agaricus (Amanita) Preissii* Fr., *cap* fleshy, convex-expanded, sticky, edge even; *stem* stuffed, mealy, pallid, rooting with turnip-shaped *volva* narrowed at the top, with a free persistent edge, *ring* placed

high on the stem and pendulous, *gills* adnate, crowded. In sandy places in forests, May. Preiss's Herb., No. 2665.<sup>†</sup>

‘A very noble species, clearly distinguished from all other known species by the nature of the volva. The size is that of *A. porphyrius* but the species should rather be compared with *A. ovoideus* and *A. solitarius*.’

Gentili (1953) suggested that Preiss' original collection was made near Perth, and redescribed the most common amanita in Kings Park (a large reserve of native vegetation close to the centre of Perth) as *A. preissii* (Figure 1). His macroscopic description is given below because he may have been confusing more than one species:

‘Cap 2–3 cm. in diameter when at the button stage, almost hemispherical (1a), gradually expanding to 5–8 cm., convexo-expanded (1e) and finally slightly depressed at the centre when adult (1g), slightly viscid in wet weather, usually smooth (1g), but at times with irregular flat warts which are hardly noticeable (1h), especially when the cap is loaded with soil (as is nearly always the case), colour white with a faint biscuit tinge towards the centre, the white always rather cream or ivory like, never chalky. A specimen with a pale salmon-coloured cap probably belongs to this species<sup>1</sup>. The cap is of medium thickness, always definitely fleshy (1g).’

‘Gills adnate to adnexed, moderately crowded, straight at first (1h) then ventricose (1g), white at first, tending to creamy colour later on.’

‘Stem 8–12 cm. high from its junction with the cap to its lower end. Over a length of 5 to 8 cm. from the top the stem is subcylindrical, tapering slightly upwards, with a diameter of 8 to 18 mm. at the top and 8 to 24 mm. at the bottom of the subcylindrical portion (stem proper). Below this is the bulbous portion, more or less turnip-shaped, nearly always with a pointed apex, 3–5 cm. high and with a maximum diameter of 22 to 43 mm., usually located between the upper third and upper half. The surface of the stem is always more or less mealy. Two specimens had rust-coloured marks on the stem.’

‘Volva as a distinct upper edge to the bulbous portion of the stem, initially as a free membranous border which in one specimen extended up to 11 mm. upwards but was already torn (1h). In a few specimens the volva extends only for 2 to 5 mm. upwards (1j), and in many specimens no volva is visible even in the young stages (1a, c). If the stem is sectioned the place where the volva has been is usually marked by a sharp edge (1d). The volva is always membranous.’

Joseph Gentili sent material to Cornelius Bas at Leiden who added microscopic details to Gentili's description, including the amyloid elongate to cylindrical spores, the remnants of the universal veil on the pileus as abundant hyphae and rather abundant globose, ellipsoid and clavate inflated cells, and absence of clamp connections (Bas 1969). Bas (1969) also described *A. ochroterrea* Gentili ex Bas from Kings Park from specimens that had been sent by Gentili as *A. preissii* forma *ochroterrea*. In addition to these two species, Gentili (1953) described other amanitas from Kings Park but the names were invalidly published (Reid 1980). No herbarium material from any of Gentili's collections from Kings Park has been located in Western Australia. We have not examined Gentili's collections known to be at L. *Amanita preissii* is believed to be poisonous (Harris & Stokes 1976).

Recent surveys of the macrofungi of Kings Park have recorded at least 13 *Amanita* Pers. species (Bougher 2010, 2011) and one of these fits the description of *A. preissii* (Figure 2). It is widespread in the Perth

<sup>†</sup>This may be a reference to *Amanita fibrilloses* O.K.Mill. that is known to occur in Kings Park.

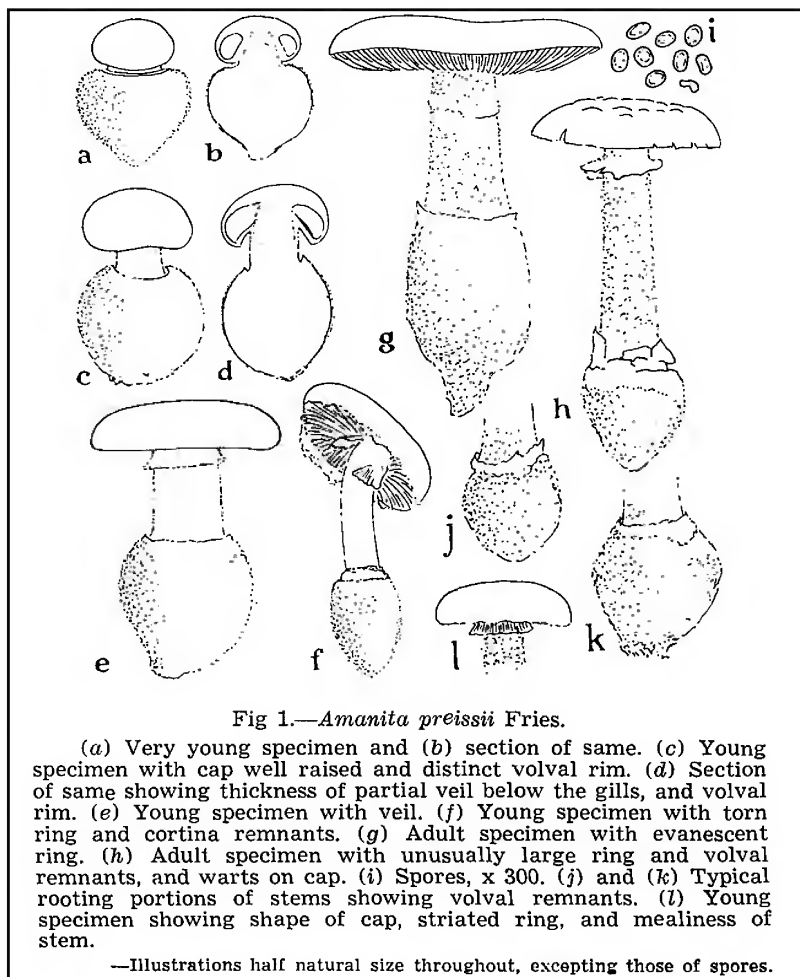


Figure 1. *Amanita preissii*. From Gentili (1953), reproduced with permission.



Figure 2. *Amanita preissii*. Neotype specimens, photographed prior to preservation. Voucher: N.L. Bougher NLB 1105 (PERTH08690766). Photograph by N.L. Bougher.

area, as noted by Gentilli (1953). Following detailed studies of this species, we nominate a collection from Kings Park as the neotype, and provide a detailed description.

Miller (1991) described *A. griseibrunnea* O.K.Mill. from collections made in Kings Park and from the grounds of Murdoch University. The appearance of *A. griseibrunnea* (Figures 3) is similar to that of *A. preissii* (Figures 1 & 2); however, in the protologue *A. griseibrunnea* is described as having a pileus that is orange-grey darkening to brownish grey, colours that are not apparent in photographs of the fresh collections. Their macroscopic and microscopic characters are similar, given the variation that occurs between collections of the same species. On this basis we synonymise *A. griseibrunnea* with *A. preissii*.

Molecular sequences are increasingly important in species descriptions. Schoch *et al.* (2012) have shown that the nuclear ribosomal internal transcribed spacer (ITS) region is an informative DNA barcode marker for fungi due to the high variability within this region; it has the highest probability of separating intra- and inter-specific samples of the broadest range of species. In their comparison of four gene regions they found that within the Basidiomycota, the ITS had most resolving power (0.79) for species discrimination, closely followed by the 28S nuclear ribosomal large subunit rRNA gene (28S) (Schoch *et al.* 2012). Other gene regions that have been used for *Amanita* spp. are  $\beta$ -tubulin, elongation factor 1- $\alpha$  (EF1- $\alpha$ ) and RNA polymerase II (RPB2) (Cai *et al.* 2014). Within the *A. preissii* collections sampled, we have found that the ITS region is very variable, and that 28S,  $\beta$ -tubulin, EF1- $\alpha$  and RPB2 show greater similarity between collections.

## Methods

Methodology is largely based on that of Tulloss (*c.* 2000); colours, including the colour of spores in deposit and other shades of white to cream (designated by letters A–G) are from Royal Botanic Garden, Edinburgh (1969) while codes for other colours are from Kornerup and Wanscher (1978). In the descriptions of basidiospores (and basidia) the notation [x/y/z] denotes x basidiospores measured from y basidiomes from z collections. Biometric variables for spores follow Tulloss (2012), i.e. '**L**' = the average spore length computed for one specimen examined and the range of such averages, '**L**' = average spore length computed for all spores measured, '**W**' = the average spore width computed for one specimen examined and the range of such averages, '**W**' = average spore width computed for all spores measured, '**Q**' = the length/breadth for a single spore and the range of the ratio of length/breadth for all spores measured, '**Q**' = the average value of **Q** computed for one specimen examined and the range of such averages, '**Q**' = the average value of **Q** computed for all spores measured'.

DNA extraction, ITS amplification, cloning and sequence analysis follow the methodology in Davison *et al.* (2013). Methodology for other gene regions is described below.

The 28S region was amplified with primers LROR and LR5 (Moncalvo *et al.* 2000). RPB2 was amplified with *amanita* specific primers Am-6 F and AM-7 R (Cai *et al.* 2014).  $\beta$ -tubulin was amplified with *amanita* specific primers Am-  $\beta$ -tubulin F and Am-  $\beta$ -tubulin R (Cai *et al.* 2014). EF1- $\alpha$  was amplified with primers 1- $\alpha$  526F and 1567R (Rehner 2001). PCR amplification of 28S, RPB2,  $\beta$ -tubulin and EF1- $\alpha$  were conducted in a total volume of 10  $\mu$ l reactions containing 1  $\times$  PCR polymerization buffer (MyTaq Reaction Buffer, Bioline) (containing 1 mM dNTP's, 3 mM MgCl<sub>2</sub>, stabilizers and enhancers), 0.1–0.25  $\mu$ M of forward and reverse primer and 5  $\mu$ M *Taq* Polymerase (Bioline). Reactions were performed in triplicates and pooled for sequencing to reduce sequencing errors.

All PCR reactions were performed in a Veriti™ thermocycler (Thermo Fisher Scientific) with the following parameters: initial denaturation of 95°C for 5 min followed by 35 cycles of 95°C denaturation for 20 s, 54°C (RPB2,  $\beta$ -tubulin) or 56°C (28S, EF1- $\alpha$ ) annealing for 20 s, 72°C elongation for 1 min, with a single final elongation at 72°C for 5 min. PCR products were visualized by gel electrophoresis (1% agarose gel pre-stained with GelGreen (1  $\mu$ l GelGreen per 100 ml of melted agarose, Biotum), 1  $\times$  Tris Acetic acid EDTA (TAE), run at 100 volts) to confirm amplification. PCR product was sent for sequencing using the commercial services of Australian Genome Research Facility. Sequence data was assembled with Geneious version 6.0.5 created by Biomatters (2016).

Phylogenetic trees of the 28S gene region were built using MEGA version 5 (Tamura *et al.* 2011). The Maximum Likelihood method was used, using a General Time Reversible model with gamma distributed rates plus invariant sites. A bootstrap consensus tree was inferred from 500 replicates.

Sequences have been deposited in GenBank; sequence identifiers and voucher information are given under each collection in this paper. The sequences were used as queries for NCBI nucleotide database using BLASTn (National Library of Medicine 2017).

### Taxonomy

***Amanita preissii*** (Fr.) Sacc. *Syll. Fung.* 5: 9 (1887). *Agaricus preissii* Fr., *Pl. Preiss.* 2: 131 (1846). *Type*: ‘In arenosis umbrosis sylvarum’ [Western Australia], May [1839–1841], *L. Preiss* 2665 (*holotype*: B n.v., destroyed in WWII). *Neotype*: Kings Park, Western Australia [precise locality withheld for conservation reasons], 25 June 2015, *N.L. Bougher* NLB 1105 (*neotype*, here designated: PERTH 08690766!) [MB171396]. ITS sequences GenBank KY290657–KY290661; 28S sequence GenBank KY290654; RPB2 sequence GenBank KY288484;  $\beta$ -tubulin sequence GenBank KY273105; EF1- $\alpha$  sequence GenBank KY273109.

*Amanita griseibrunnea* O.K. Mill., *Canad. J. Bot.* 69(12): 2693 (1992), *syn. nov.* *Type*: Murdoch University forest, Western Australia, 7 May [originally published as June] 1989, *O.K. & H.H. Miller; E. & P. Davison* OKM 23629 (*holotype*: PERTH 02224518!) [MB517339].

*Pileus* 25–82 mm wide, to 6 mm thick, white to ivory white (B) aging saffron (4B2–5B2–B4), without surface staining or bruising, initially convex becoming plane with depressed centre and decurved margin, surface dry; margin non-striate, appendiculate with cream (C) to pale saffron to pale cinnamon (4B2–6B2) floccules from partial veil adhering. *Universal veil* on *pileus* adnate, felted to floccose, sticky, as small, thin patches in centre of disc, white aging cream (F) to saffron (5A3–B4). *Lamellae* adnexed to adnate, subcrowded, white to ivory white (B), to 12 mm broad, margin concolorous, fimbriate; *lamellulae* frequent in several lengths, shortest truncate, longest attenuate. *Stipe* 40–90 mm long, 8–18 mm wide, cylindrical or tapering upwards, white to ivory white (B), surface below partial veil floccose to scurfy with ornamentation white to ivory white (B) bruising saffron (4B2–5B2). *Partial veil* superior, descendent, fragile with margin ragged, flaring or adpressed, striate above, white to ivory white (B) to saffron to pale cinnamon (4B2–6B2). *Bulb* 20–40  $\times$  15–35 mm, napiform to ovoid with tapered base, white to ivory white (B) bruising yellow. *Remains of universal veil* at top of bulb as a fragile, easily detached free limb or as a narrow rim or as concentric bands on the stipe or as flat warts, white or ivory white (B) bruising yellow. *Pileus and stipe context* white to ivory white (B), yellowing in stipe, stipe solid becoming hollow. *Smell* chemical, chlorine. *Spore deposit* white becoming cream (C) with age. (Figures 1–3)

*Basidiospores* [340/11/11] (7.5–)8.5–11.5(–12.5)  $\times$  5–6.5(–7.5)  $\mu\text{m}$  (**L** = 8.8–11.2  $\mu\text{m}$ ; **L'** = 9.7  $\mu\text{m}$ ; **W** = 5.2–6.0  $\mu\text{m}$ ; **W'** = 5.6  $\mu\text{m}$ ; **Q** = (1.11–)1.43–2.09(–2.27); **Q** = 1.65–2.13; **Q'** = 1.75), colourless, thin-walled, smooth, amyloid, elongate or cylindrical, occasionally ellipsoid, contents monogutullate; apiculus sublateral, cylindrical, c. 1  $\times$  1  $\mu\text{m}$ , truncate. *Pileipellis* not clearly differentiated in young specimens, to 180  $\mu\text{m}$  thick in old specimens, colourless or pale yellow in  $\text{NH}_4\text{OH}$ ; filamentous hyphae 2–10  $\mu\text{m}$  wide, colourless, with gelatinising walls with widest constricted at septa, radially orientated with some interweaving; inflated cells not observed; vascular hyphae 2–10  $\mu\text{m}$  wide, occasionally branched, very infrequent; clamp connections not observed. *Pileus context* of dominant or equal filamentous hyphae 3–35  $\mu\text{m}$  wide, with widest constricted at septa, thin-walled, colourless; inflated cells to 220  $\times$  40  $\mu\text{m}$  when clavate, to 250  $\times$  20  $\mu\text{m}$  when cylindrical, to 250  $\times$  35  $\mu\text{m}$  when ventricose, colourless; vascular hyphae very infrequent, 3–10  $\mu\text{m}$  wide, pale yellow; clamp connections not observed. *Lamella trama* bilateral, divergent. *Central stratum* of thin-walled, colourless, filamentous hyphae 3–10  $\mu\text{m}$  wide; inflated cells not observed; vascular hyphae not observed; clamp connections not observed. *Subhymenial base* with angle of divergence 10°–15° from central stratum with filamentous hyphae following smooth broad curve to subhymenium, of dominant thin-walled, colourless, frequently branched filamentous hyphae 3–20  $\mu\text{m}$  wide, widest proximal to subhymenium and constricted at septa; inflated cells frequent, colourless, to 100  $\times$  20  $\mu\text{m}$ , clavate, ellipsoidal, ventricose or cylindrical, terminal or intercalary; vascular hyphae very infrequent, 3–5  $\mu\text{m}$  wide, pale yellow; 1 clamp connection observed. *Subhymenium* with basidia arising terminally from barely inflated to inflated hyphal segments to 15  $\mu\text{m}$  wide; clamp connections not observed. *Lamella edge tissue* sterile, with frequent to infrequent inflated cells clavate or pyriform or cylindrical, 15–55  $\times$  7–20  $\mu\text{m}$ , colourless, disarticulating; clamp connections not observed. *Basidia* [320/11/11] (33–)37–60(–67)  $\times$  (9–)10–14(–16)  $\mu\text{m}$ , thin-walled, colourless, c. 80% 4-spored, c. 10% 3-spored, c. 8% 2-spored, c. 2% 1-spored, sterigmata to 7  $\times$  2  $\mu\text{m}$ ; 1 clamp connection observed. *Universal veil on pileus* merging into pileipellis, not layered, with elements irregularly disposed; filamentous hyphae 3–10  $\mu\text{m}$  wide, colourless, gelatinising; inflated cells dominant, to 100  $\times$  100  $\mu\text{m}$  when spherical, to 60  $\times$  50  $\mu\text{m}$  when ovoid, to 90  $\times$  60  $\mu\text{m}$  when pyriform, to 110  $\times$  35  $\mu\text{m}$  when clavate, intercalary or in terminal chains of up to 3 cells, colourless or occasionally with pale brown contents, gelatinising; vascular hyphae very infrequent, 3–6  $\mu\text{m}$  wide, pale yellow; clamp connections not observed. *Universal veil on stipe base* without clear orientation; filamentous hyphae dominant or equal, 3–20  $\mu\text{m}$  wide, colourless or occasionally with pale brown contents, gelatinising; inflated cells to 110  $\times$  80  $\mu\text{m}$  ovoid, to 60  $\times$  60  $\mu\text{m}$  spherical, to 95  $\times$  60  $\mu\text{m}$  pyriform, to 110  $\times$  30  $\mu\text{m}$  clavate, intercalary or in terminal chains of up to 2 cells, colourless or occasionally with pale brown contents, gelatinising; vascular hyphae very infrequent, 2–3  $\mu\text{m}$  wide, pale yellow; clamp connections not observed. *Stipe context* longitudinally acrophysalidic; filamentous hyphae 2–12  $\mu\text{m}$  wide, colourless; acrophysalides dominant, to 600  $\mu\text{m}$  long  $\times$  40  $\mu\text{m}$  wide, clavate, terminal, colourless, gelatinising; vascular hyphae infrequent to frequent, 3–13  $\mu\text{m}$ , brownish yellow, often sinuous; clamp connections not observed. (Figure 4)

*Diagnostic features.* Small to medium fruiting bodies with a white or ivory white pileus that ages saffron. The universal veil is thin and sticky, forming small patches in the centre of the disc. The pileus is initially white but ages cream to saffron. There are often cream to saffron to pale cinnamon floccules from the ring attached at the margin of the pileus. The gills are white to ivory white; the stipe is covered with white to ivory white floccose ornamentation that bruises saffron. The soft, fragile ring is superior, initially white, but becomes cream to saffron to pale cinnamon with age. The bulb is ovoid with a tapered base and bruises yellow. Old fruiting bodies have a strong chlorine odour. The spores are elongate or cylindrical and amyloid. The universal veil on the pileus has elements with no dominant orientation and is predominantly composed of inflated cells that may be in short chains. Clamp connections are absent.



Figure 3. *Amanita griseibrunnea*. Type specimens from Murdoch University forest, photographed prior to preservation. Voucher: O.K. & H.H. Miller; E. & P. Davison OKM 23629 [E 506] (PERTH 02224518). Photograph by N.L. Bougher.

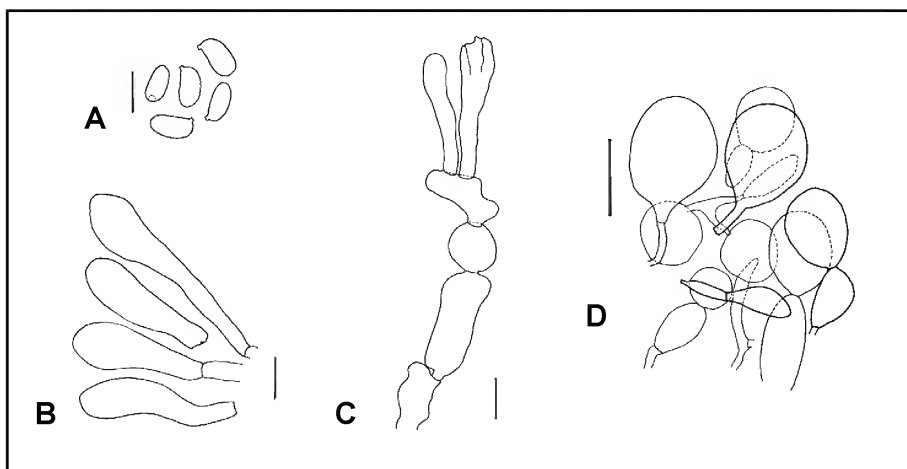


Figure 4. *Amanita preissii*. A – spores from print; B – lamella edge cells; C – squash of basidia and subhymenium; D – scalp section of universal veil on pileus. Scale bars = 10  $\mu\text{m}$  (A–C); 50  $\mu\text{m}$  (D). Line drawings from N.L. Bougher NLB 1105 (PERTH 08690766).

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 18 June 1995, *E.M. Davison* 7-1995 & *P.J.N. Davison* (PERTH, ITS GenBank JX398317, KY290667–KY290671, 28S GenBank KY290656); 2 July 1995, *E.M. Davison* 15-1995 & *P.J.N. Davison* (PERTH, ITS GenBank JX398318,  $\beta$ -tubulin GenBank KY273106, EF1- $\alpha$  GenBank KY273107); 13 June 2004, *E.M. Davison* 2-2004 & *P.J.N. Davison* (PERTH); 30 June 2009, *E.M. Davison* 3-2009 & *P.J.N. Davison* (PERTH, ITS GenBank KY290672–KY290676, 28S GenBank KY290655); 22 May 2005, *L.E. McGurk* 2005-35 LM (PERTH, ITS GenBank JX398322, KY290662–KY290666, EF1- $\alpha$  GenBank KY273108, RPB2 GenBank KY288485); Lightening Swamp, 2007, *L.E. McGurk* 24-2007 (PERTH); 7 May 1989, *O.K. Miller* 23623 (PERTH); 21 May 1989, *O.K. Miller* 23663 & *H. Miller* (PERTH).

*Fruiting period.* April to July.

*Distribution and habitat.* Solitary to gregarious in sandy soil and lateritic gravel, in native vegetation; nearby plants include *Allocasuarina fraseriana*, *Acacia pulchella*, *Corymbia calophylla*, *Callitris* sp., *Eucalyptus gomphocephala*, *E. marginata*, *Macrozamia fraseri* and *Pinus pinaster*. Occurs in the Swan Coastal Plain SWA2 Perth and JAF01 Northern Jarrah Forest IBRA subregions (as defined in Department of the Environment 2013).

*Conservation status.* To be listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (M. Smith pers. comm.).

*Suggested common name.* Cinnamon-ring *Lepidella*.

*Affinities based on molecular sequences.* The ITS region is used as a barcode marker for fungi with a resolving power of 0.79 within the Basidiomycota (Schoch *et al.* 2012). We have, however, found that this region is very variable in the *A. preissii* collections sequenced. This region is 631 base pairs long in our analysis, and differences between 23 cloned sequences from five collections from three locations are from 0.16–3.65%. There are no exact matches on GenBank. The closest sequence is KP137085 *Amanita* sp. AD-C55022 clone 12\_3, with 94% similarity and 100% query coverage.

Schoch *et al.* (2012) found that the 28S gene has better resolving power in some taxonomic groups and we have found that sequences of this gene region from different collections are much more similar. A Maximum Likelihood tree based on a subset of the 28S gene sequences used by Li *et al.* (2016) shows that *A. preissii* falls within *A. sect. Lepidella* (E.-J. Gilbert) Corner & Bas clade III (Figure 5). The closest sequence is HQ539749 *A. sublutea* (Cleland) E.-J. Gilbert PSC 2401 from South Australia.

The  $\beta$ -tubulin partial sequence is 380 base pairs long in our analysis. There are no differences between the sequences obtained from two collections from two locations. There are no exact matches on GenBank. The closest sequence is KJ466517 *A. modesta* Corner & Bas HKAS75405 with 90% similarity and 89% query coverage.

The EF1- $\alpha$  partial sequence is 511 base pairs long in our analysis. The differences between sequences obtained from three collections from three localities are 0.00–0.18%. There are no exact matches on GenBank. The closest sequences are KJ481996 *A. virgineoides* Bas HKAS79691, KJ481943 *A. manginiana* Har. & Pat. HKAS56933 and KJ481945 *A. modesta* HKAS75405 all with 87% similarity and 96% query coverage.

The RPB2 partial sequence is 598 base pairs long in our analysis. There is no difference between two sequences obtained from two collections from different localities. There are no exact matches on

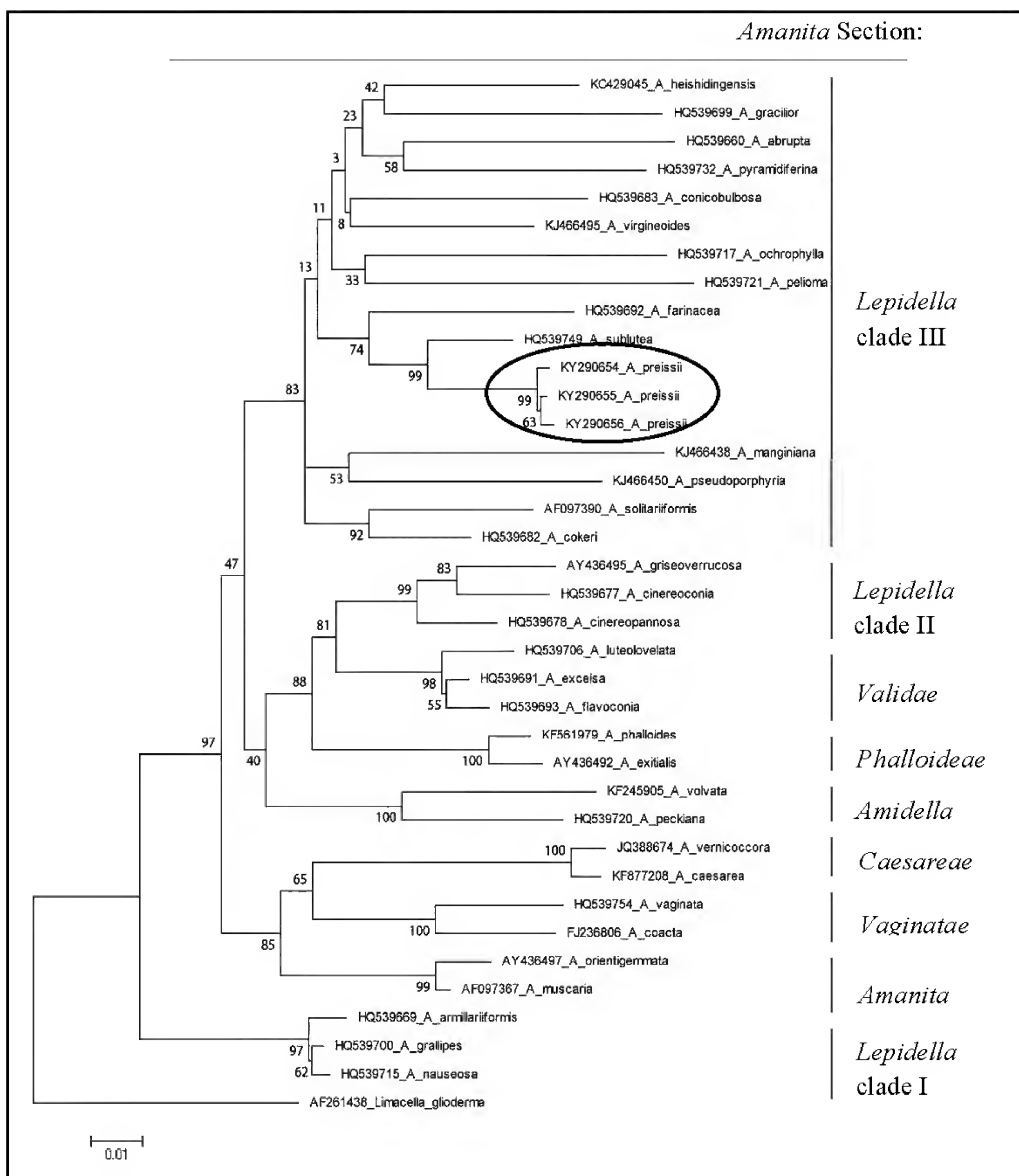


Figure 5. Molecular phylogenetic analysis by Maximum Likelihood method of 28S sequences showing the position of *Amanita preissii* in *A.* sect. *Lepidella* clade III. Bootstrap support values are shown above the nodes. The tree is rooted on *Limacella glioderma* (Fr.) Maire. Reproduced from Li *et al.* (2016).

GenBank. The closest sequences are KJ466605 *A. modesta* HKAS75405 with 91% similarity and 100% query coverage and KJ466606 *A. oberwinklerana* Zhu L. Yang & Yoshim. Doi HKAS77330 with 91% similarity and 99% query coverage.

*Notes.* The distinguishing characters of *A. preissii* are given by Bas (1969) and Reid (1980), with the macroscopic characters based on Gentili (1953). Bas (1969) placed *A. preissii* in *A.* sect. *Lepidella* stirps *Preissii* based on its overall size and colouration, volval limb, spore shape and size, and basidia without clamp connections. He distinguished it from other species in this stirps because of the absence

of yellow bruising in the context, by the shape of the bulb, spore shape and size, abundance and shape of inflated cells in the universal veil on the pileus, and occurrence in Western Australia. The description by Reid (1980) is based on that of Bas (1969). Reid (1980) distinguishes *A. preissii* from other Australian species on the basis of pileus colour, overall size, spore shape and absence of clamp connections. The collections described in this paper fit the descriptions given by Gentili (1953), Bas (1969) and Reid (1980).

Miller's description of *A. griseibrunnea* (Miller 1991) differs from that of Gentili (1953), Bas (1969) and Reid (1980) in the colour of the pileus which he describes as 'orange-grey (5B2), darkening to brownish grey (5B2 to 5C2)'. However the photograph of the *A. griseibrunnea* type (which was not published) shows a white or pale pileus that either does not have, or only has a very slight tint of orange-grey (Figure 3). *Amanita preissii* develops these colours with age (Figure 2). Other macroscopic characters are similar.

Microscopic characters are also similar. The spores of the three *A. griseibrunnea* collections are of similar size and shape to two collections of *A. preissii* from Kings Park (the site of Gentili's collections and one of the sites from which *A. griseibrunnea* was described) (*A. griseibrunnea* [60/3/3]  $9-12(-12.5) \times 5-6.5 \mu\text{m}$  ( $L = 9.8-11.2 \mu\text{m}$ ;  $L' = 10.8 \mu\text{m}$ ;  $W = 5.3-6.0 \mu\text{m}$ ;  $W' = 5.6 \mu\text{m}$ ;  $Q = (1.58-1.64-2.27)$ ;  $Q' = 1.74-2.13$ ;  $Q'' = 1.92$ ), *A. preissii* (Kings Park collections PERTH 08690766, PERTH 08774765)  $9-11(-12) \times 5-6 \mu\text{m}$  ( $L = 10-10.6 \mu\text{m}$ ;  $L' = 10.3 \mu\text{m}$ ;  $W = 5.2-5.5 \mu\text{m}$ ;  $W' = 5.3 \mu\text{m}$ ;  $Q = (1.64-1.80-2.10(-2.20))$ ;  $Q' = 1.92-1.95$ ;  $Q'' = 1.94$ )). The universal veil on the pileus and at the stipe base is of similar structure in both species and is composed of dominant or equal inflated cells that are terminal or in short chains of two, and of spherical, ellipsoid, ovoid, clavate or pyriform shape (Figure 6).

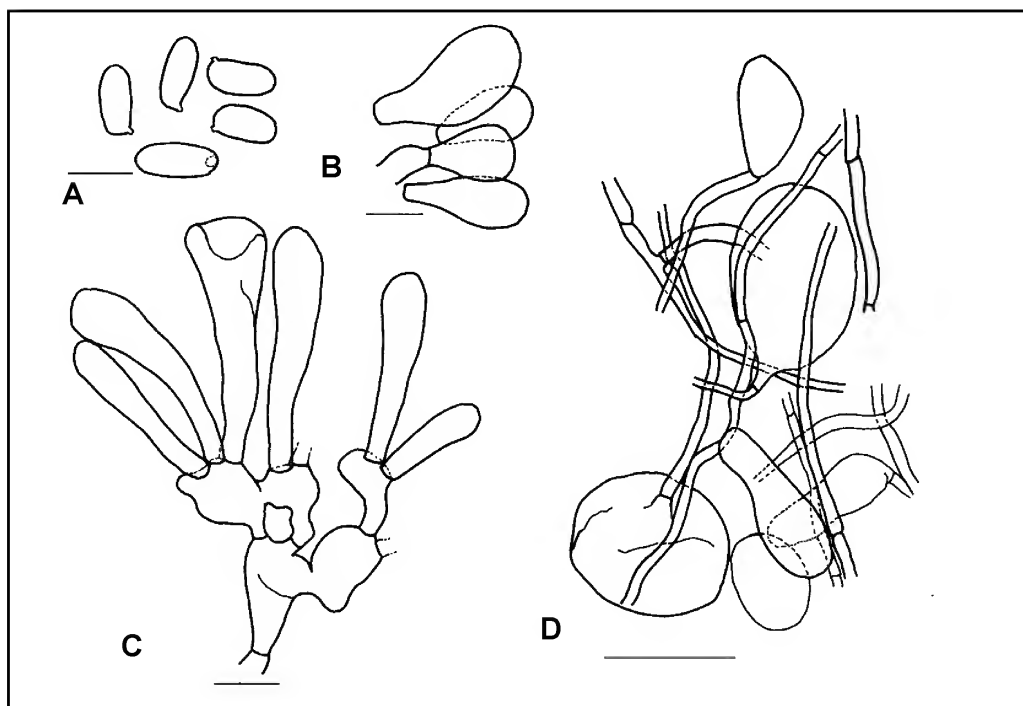


Figure 6. *Amanita griseibrunnea* type. A – spores from print; B – lamella edge cells; C – squash of basidia and subhymenium; D – squash of universal veil on pileus. Scale bars = 10  $\mu\text{m}$  (A–C); 50  $\mu\text{m}$  (D). Line drawings from O.K. & H.H. Miller; E. & P. Davison OKM 23629 [E 506] (PERTH 02224518).

The type locality for *A. griseibrunnea* is the grounds of Murdoch University, where *A. preissii* is common. The other locality where it was collected is Kings Park, where *A. preissii* also occurs.

Attempts to obtain usable DNA from *A. griseibrunnea* (PERTH 02224518) have not been successful.

On the basis of its appearance, apart from the colour of the pileus (which is not supported by contemporary photographs), microscopic characters and locations where it was collected, *A. griseibrunnea* is synonymised with *A. preissii*.

In his comments about *A. griseibrunnea*, Miller (1991) makes no mention of *A. preissii* even though he was aware of its redescription by Gentili (1953) and Bas (1969). Miller considered that there were six Western Australian taxa in *A. sect. Lepidella* stirps *Preissii* which formed a complex (Miller & Davison 1994). He examined Gentili's collections of *A. preissii* in L in 2003 but took the matter no further (O.K. Miller pers. comm.).

### Acknowledgements

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## Revision of the south-western Australian genus *Anticoryne* (Myrtaceae: Chamelaucieae)

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### Abstract

Rye, B.L. Revision of the south-western Australian genus *Anticoryne* (Myrtaceae: Chamelaucieae). *Nuytsia* 28: 205–215 (2017). *Anticoryne* Turcz. comprises three species occurring in a relatively small portion of south-western Australia. Stamen morphology is of diagnostic importance for the genus, as is its very dark seed colour. In this revision of the genus, the new species *A. melanosperma* Rye is named and a lectotype is selected for *A. ovalifolia* (F.Muell.) Rye. All species have conservation priority.

### Introduction

This paper presents a taxonomic revision of the myrtaceous genus *Anticoryne* Turcz. *Anticoryne* belongs to the *Hysterobaeckea* (Nied.) Rye group within the tribe Chamelaucieae DC. Its three species are endemic to the South West Botanical Province of Western Australia, extending from near the centre of the province south-eastwards to the coast. Similar methods were used to those outlined in a recent revision of a related genus, *Babingtonia* Lindl. (Rye 2015).

### Taxonomic history

The first collection of *Anticoryne* was made from the Mt Barren Ranges in 1848 during James Drummond's fifth expedition. Turczaninow (1852) named the species *A. diosmoides* Turcz., placing it in his new genus *Anticoryne*, which he considered similar to *Harmogia* Schauer in some respects but with more numerous stamens and differences in the anther connective.

A second species of *Anticoryne* was collected by George Maxwell, who had accompanied Drummond during part of the fifth expedition (Erickson 1969) when *A. diosmoides* was discovered. The new species also occurred in the Mt Barren Ranges. It was named *Harmogia ovalifolia* F.Muell. (Mueller 1860) and subsequently transferred to the genus *Baeckea* L. (Mueller 1864).

Bentham (1867) combined the two species under the name *Baeckea ovalifolia* (F.Muell.) F.Muell. and placed them in sect. *Babingtonia* (Lindl.) Benth. & Hook.f., citing only one specimen (the type) of each taxon. Domin (1923) attempted to reinstate the older name by making the new combination *Baeckea diosmoides* (Turcz.) Domin, but this was not legitimate since the epithet *diosmoides* had already been used for an eastern Australian species of *Baeckea*.

A third, unnamed member of the genus was given the phrase name *B. sp.* Hyden (J.M. Brown 141) by Malcolm Trudgen in 1996. For many years the specimens of *A. diosmoides* were housed as *B. ovalifolia* or *B. aff. ovalifolia* at PERTH, until Trudgen placed them under the phrase name *B. sp.* Thumb Peak (A.S. George 7105) in July 2003. Use of the name *Anticoryne diosmoides* was restored as part of the current study of Chamelaucieae in August 2003, and nine years later the new combination *A. ovalifolia* (F.Muell.) Rye was published (in Rye & Trudgen 2012).

*Anticoryne* was included in an interim key to genera (Rye 2009), in which it was separated from *Babingtonia* by a combination of incomplete character differences and by its distinct distribution. A further difference between the two genera indicated in Rye (2015) was that leaves were more flattened in *Anticoryne* than in *Babingtonia*.

### Molecular evidence

Molecular cladograms based on two chloroplast DNA regions (Lam *et al.* 2002) placed *A. ovalifolia* [as *Baeckea ovalifolia*] in a sister position to *Babingtonia camphorosmae* (Endl.) Lindl.

Using two further chloroplast regions and also the nuclear ETS region, Wilson *et al.* (2005; 2007) placed both *Anticoryne* and *Babingtonia* in a clade that also contained *Malleostemon* J.W.Green, *Scholtzia* Schauer, *Tetrapora* Schauer [as *Baeckea preissiana* Schauer] and the *Baeckea robusta* F.Muell. group [the single species sampled identified as *B. sp.* ‘blackallii’]. In these analyses, a second species of *Babingtonia* was sampled; this strongly associated with *B. camphorosmae*, while *Anticoryne* was sister to the pair of them.

Analysis of further species has shown that *B. sp.* Hyden is strongly supported as sister to the strongly supported pairing of *A. diosmoides* and *A. ovalifolia* (Peter Wilson pers. comm.). This clade of three species is sister to a clade containing *Babingtonia*, *Malleostemon*, *Scholtzia* and miscellaneous unplaced species, with *Tetrapora* sister to *Anticoryne* plus the latter’s sister clade. If this tree reliably represents the relationships between these genera, then it supports the recognition of *Anticoryne* as a distinct genus. An alternative would be to combine all genera into a greatly enlarged *Babingtonia s. lat.* but that would make a large and unwieldy genus, which would be very difficult to justify on morphological grounds. It therefore appears best to retain all five genera for now and to reassess generic boundaries later when more evidence becomes available.

### Distinguishing features of *Anticoryne*

The three species of *Anticoryne* are small to medium-sized shrubs, which regenerate by seed after fires. Their leaves have numerous, very small oil glands visible on both surfaces of the blade. Flowers are large in comparison with most other Chamelaucieae, with a diameter ranging from 10 to 16 mm. Unlike most other members of the *Hysterobaeckea* group, *Anticoryne* has very dark brown to black seeds.

Stamen characters are very important. There are 12 to 45 stamens, usually in a complete circle, but in one species arranged in an irregular circle or mostly in antisepalous groups of two to four with some large gaps. Stamens are free to the base, and have a somewhat to very flattened filament that tapers and is directed somewhat inwards towards the top. The anthers are broadly ovoid to broader distally, sometimes  $\pm$  truncate or slightly 2-lobed at apex, and yellow pollen is extruded from two terminal pores. The connective gland is not obvious as a distinct structure,

being largely or fully incorporated within the body of the anther, appearing as a somewhat swollen connective prior to pollen release, although it may also protrude slightly below the thecae. This kind of anther, with the connective gland fused to other parts of the stamen, is found in all members of the *Hysterobaekea* group.

The four genera indicated by the molecular data as being closely related to *Anticoryne* all show at least subtle differences in anther morphology. Three of them, *Babingtonia*, *Scholtzia* and *Tetrapora*, were named prior to *Anticoryne* while *Malleostemon* was erected much more recently.

*Malleostemon* is readily distinguished from *Anticoryne* by its 1-loculate ovary and indehiscent fruits. *Scholtzia* differs from *Anticoryne* in having very reduced ovule numbers and indehiscent fruits, while *Tetrapora* is distinguished by its small, usually globular anthers and thinly crustaceous seeds. All three genera also differ from *Anticoryne* in having smaller flowers and narrower stamen filaments.

As is evident from the key to genera and sections of Western Australian Myrtaceae (Rye 2009), *Babingtonia* is most similar to *Anticoryne* on morphological grounds. Its anthers differ either in being more 2-lobed or in having lateral grooves. A character that may give a more complete separation than those used previously is the darker seed colour of *Anticoryne*. Other differences between the genera are that *Anticoryne* occurs east of *Babingtonia*'s distribution (Figure 1), and flowering occurs mainly in spring in *Anticoryne* and mainly in summer in *Babingtonia*.

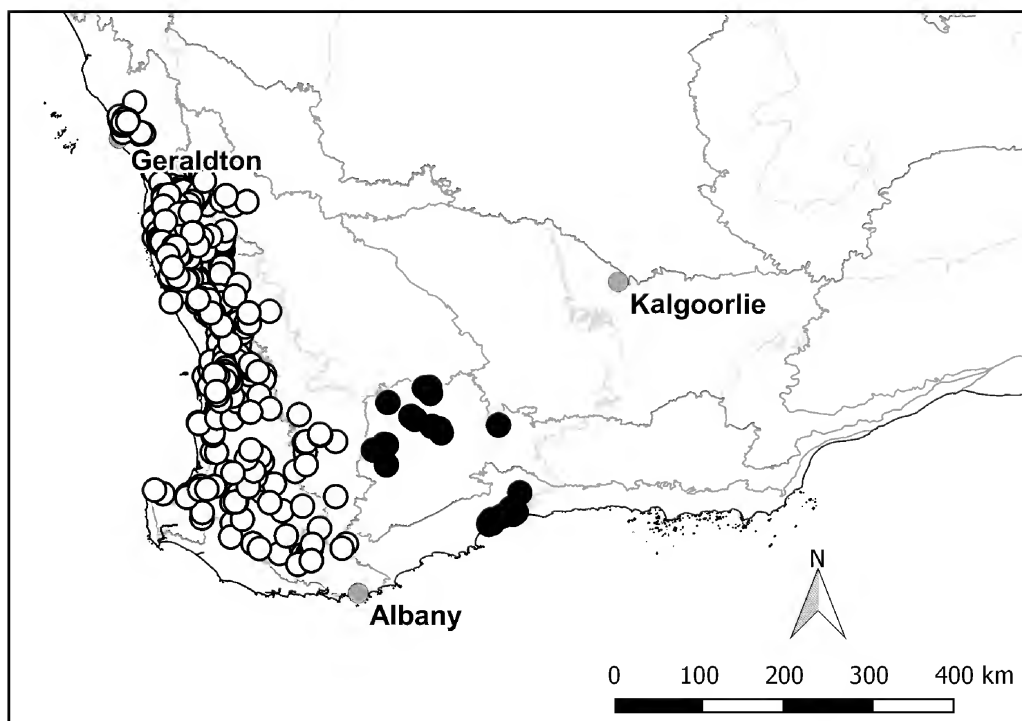


Figure 1. Distribution of *Anticoryne* (●) and *Babingtonia* (○).

### Key to *Anticoryne* and four related genera

1. Ovules of constant number, being solitary or 2 superposed in each loculus depending on the species. Fruits indehiscent, usually 2- or 3-locular (Carnarvon area–near Bunbury–Corrigin area)..... **SCHOLTZIA**
- 1: Ovules of variable number, (2–)4–16 per loculus, radially arranged or (when only 2 present) collateral. Fruits either dehiscent by 2 or 3 terminal valves or indehiscent and 1-locular.
  2. Stamens mostly 3–12, with a thick filament
    3. Ovary 1-locular. Fruits indehiscent (Carnarvon area–near Hyden–E of Kalgoorlie)..... **MALLEOSTEMON**
    - 3: Ovary 3-locular. Fruits dehiscent by 3 valves (Winchester–S coast–Esperance area).... **TETRAPORA**
  - 2: Stamens mostly 3–40, if less than 12 then with a very compressed filament
    4. Flowers 1–16 per peduncle, with sepals 0.2–1.1(–1.5) mm long, petals 1.3–5(–6.5) mm long and 3–26 stamens. Seeds pale to dark brown (N of Northampton–Mount Barker area)..... **BABINGTONIA**
    - 4: Flowers 1 per peduncle, with sepals 1.1–1.6 mm long, petals 4–7 mm long and 12–45 stamens. Seeds very dark brown or black (N of Hyden–Fitzgerald River NP)..... **ANTICORYNE**

### Generic treatment

**Anticoryne** Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersbourg* 10: 332 (1852). Type: *Anticoryne diosmoides* Turcz.

*Shrubs* up to 1.8 m high, single-stemmed at base, glabrous, with opposite and decussate, antrorse to widely spreading leaves densely and relatively uniformly distributed along the branchlets and flowers densely clustered towards ends of branchlets. *Petioles* usually well defined, much shorter than the blade. *Leaf blades* somewhat to much broader than thick, dotted with numerous oil glands on both surfaces; abaxial surface convex except for the midline which is variously keeled, flattened or grooved. *Peduncles* ± absent or up to 7 mm long, 1-flowered. *Bracteoles* persistent at anthesis and often in fruit, with sides incurved. *Pedicels* 1–5 mm long. *Hypanthium* adnate to ovary for most of its length; adnate portion obconic or broadly obconic, rugose-pitted; free portion fairly erect or spreading. *Sepals* 5, erect, persistent and closed inwards in fruit, much shorter than the petals, largely to completely petaline, sometimes with a herbaceous dorsal ridge. *Petals* 5, widely spreading, shed before fruit matures, very shortly clawed, very broadly to compressed-obovate, white or pale pink inside, pink outside where exposed in bud. *Antipetalous colleter*s (when present) minute, slender. *Staminodes* absent or very rare. *Stamens* 12–45, free, in a fairly continuous or irregular circle or sometimes mostly antisepalous, the longest ones usually strictly antipetalous or at the margins of the petal claws. *Filaments* not fully erect as leaning inwards towards the stigma, flattened. *Anthems* highly modified, with the 2 cells closely fused, dehiscent by 2 pores; connective gland largely hidden or noticeably protruding at base. *Ovary* 3-locular, partly superior (summit raised at the centre); placentas large, peltate and shield-like, ± sessile or with a very short stalk near the base, with large attachment points around margin; ovules usually 4–13 per loculus. *Style* 2.2–3 mm long, with base inserted in a narrow depression in the summit of the ovary, becoming reddish but the enclosed part pale; stigma capitate, circular from top view, small. *Fruits* 1/2 to largely superior, few- to many-seeded, somewhat 3-lobed; valves 3, opening widely; placentas with adaxial surface angled shallowly along centre above a moderately broad attachment towards base. *Seeds* radially arranged on the placenta, 0.9–1.3 mm long, distinctly to scarcely faceted,

very dark brown or black, scarcely colliculate to shortly tuberculate; hilum small or moderately large. *Chaff pieces* faceted or compressed, crustaceous, brown.

**Distribution.** *Anticoryne* extends from the Hyden area south-east to Fitzgerald River National Park (Figure 1). Geographical separation of all three species appears to be complete although two of them are largely or fully restricted to the same national park (see below) in the south. The northern species is separated from the two southern species by more than 100 km.

**Phenology.** Flowering is recorded mainly from August to November, with no apparent difference in flowering time between the species.

**Etymology.** From the Greek *anti-* (against) and *koryne* (club), presumably in reference to the club-like anthers.

**Co-occurrence.** Two of the species are endemic to an area close to the south coast of Western Australia between Bremer Bay and Ravensthorpe, where they occupy a very similar habitat, mainly on quartzite, extending from Middle Mt Barren north-east to Annie Peak in the Eyre Range. *Anticoryne ovalifolia* is largely restricted to an area to the south-east of the range of *A. diosmoides*, but less than 10 km away, although there is one record of it from the north-east.

### Key to species of *Anticoryne*

1. Leaf blades  $\pm$  oblong in outline, 0.6–1 mm thick. Peduncles  $\pm$  absent but pedicels 1.3–2.5 mm long. Seeds scarcely faceted,  $\pm$  reniform, with a shortly tuberculate outer surface (Hyden–Dongolocking NR–near Forrestania)..... ***A. melanosperma***
- 1: Leaf blades very broadly obovate to almost linear, not very thick. Peduncles 2.5–7 mm long, often exceeding the 1–5 mm long pedicels. Seeds faceted, with a smooth to slightly colliculate outer surface.
2. Leaf blades 1.2–2.3 mm wide,  $\pm$  entire. Outer sepals slightly ridged. Stamens 20–45, in a continuous circle (Middle Mt Barren–Annie Peak)..... ***A. diosmoides***
- 2: Leaf blades 2–4 mm wide, the margins with coarse laciniae up to 0.2 mm long. Outer sepals prominently ridged. Stamens 12–17, with gaps present (near East Mt Barren) ..... ***A. ovalifolia***

***Anticoryne diosmoides*** Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg* 10: 332 (1852). *Baeckea diosmoides* (Turcz.) Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přir.* 2: 83 (1923), *nom. illeg. non* Sieber ex DC., *Prodr.* 3: 230 (1828). *Type:* Nova Hollandia [Stirling Range to Cape Riche and Mt Barren Range, Western Australia], 1847–1849, *J. Drummond* 5: 124 (*holo:* KW 001001300; *iso:* MEL 72890, PERTH 06391176).

*Baeckea* sp. Thumb Peak (A.S. George 7105), G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 387 (2000); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 25 October 2016].

**Illustration.** W.E. Blackall & B.J. Grieve, *How Know W. Austral. Wildflowers* 3A: 87 (1980) [as *Baeckea ovalifolia*].

**Shrub** erect, open, 0.5–1.8 m high, commonly c. 1.5 m wide; flowering branchlets with usually 1–4 pairs

of flowers. *Petioles* 0.8–1.1 mm long. *Leaf blades* mostly linear to narrowly ovate, 6–8 mm long, 1.2–2.3 mm wide, thickened towards apex but thin elsewhere, green, entire or slightly serrate along the margins, without an apical point; abaxial surface convex, with oil glands in 2 or 3 main rows on each side of the midvein; adaxial surface concave except towards apex. *Peduncles* 2.5–5 mm long. *Bracteoles* narrowly ovate or  $\pm$  narrowly elliptic (when flattened), 3–4 mm long. *Pedicels* 1–4 mm long. *Flowers* 12–16 mm diam. *Hypanthium* c. 1.5 mm long, c. 4 mm wide; free portion c. 0.5 mm long, often reddish-tinged. *Sepals* depressed-ovate, 1.2–1.5 mm long, c. 3 mm wide, deep pink with a white border, entire, very obtuse, not keeled. *Petals* 5–7 mm long, white or pale pink. *Stamens* 20–40(–45), in a continuous circle (with the bases of the filaments abutting each other or separated by a gap that is much narrower than the filaments) and tending to alternate in length. *Longest filaments* 2–2.5 mm long, the broadest ones 0.3–0.5 mm wide at base, red-tinged at summit. *Anthers* broadly and irregularly obovoid, c. 0.5 mm long, c. 0.35 mm wide. *Ovary* 1/2–2/3 inferior; ovules 7–13(–15) per loculus. *Style* 2.2–3.3 mm long; stigma c. 0.2 mm diam. *Fruits* 1/2–2/3 superior, 2–2.5 mm long, 3.5–4 mm diam. *Seeds* strongly faceted, 1.1–1.3 mm long, 0.4–0.7 mm wide, 0.6–0.8 mm thick, minutely colliculate, shiny; hilum not exceeding 0.1 mm diam.

*Diagnostic features.* Distinguished from the other species of *Anticoryne* by its longer petioles and more numerous stamens, also tending to have more numerous ovules.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 3 Oct. 2008, S. Barrett 1808 (PERTH); 23 Sep. 1925, C.A. Gardner 1862 (PERTH); 2 Dec. 1960, A.S. George 1948 (PERTH); 2 Nov. 1965, A.S. George 7253 (PERTH); 16 July 1970, A.S. George 10086 (PERTH); 29 Nov. 2002, M. Hislop 2889, S. Barrett & J.A. Cochrane (PERTH); 10 Oct. 2003, M. Hislop 3039 (NSW, PERTH); 27 Oct. 1967, K.R. Newbey 2728 (PERTH).

*Distribution and habitat.* Endemic to the Barren Range in Fitzgerald River National Park, extending from Middle Mt Barren north-east to Annie Peak (Figure 2). Occurs on quartzite pavements and rocky slopes, in heath, sometimes with *Melaleuca citrina* or *Banksia*.

*Phenology.* Flowers mainly from September to November, with mature fruits recorded from October to December.

*Conservation status.* Listed by Smith (2017) as Priority Four under Department of Parks and Wildlife Conservation Codes for Western Australian Flora. The known range of *A. diosmoides* is c. 40 km long and entirely contained within a large national park; therefore, the species is considered rare but not currently threatened.

*Notes.* This species is unusual in sometimes having shorter stamens directly opposite the centre of a petal than those at the margins of the petal claw, this effect resulting from the tendency for the species to have alternating long and short stamens. One specimen (A.S. George 7253) has greater numbers of stamens than the other specimens examined. That specimen was recorded as having up to 45 stamens and up to 15 ovules by Sandra Maley (unpubl. data), although the current study recorded a maximum of 41 stamens and 13 ovules based on a small sample of flowers.

*Anticoryne diosmoides* seems to occupy a very similar habitat to *A. ovalifolia*, and there is hardly any geographic separation of the two taxa. While obviously closely related, the two species are very easy to distinguish from one another. *Anticoryne diosmoides* has longer petioles, and it has longer, narrower leaves than the upper leaves (on flowering branches) of *A. ovalifolia*, although leaves borne on the

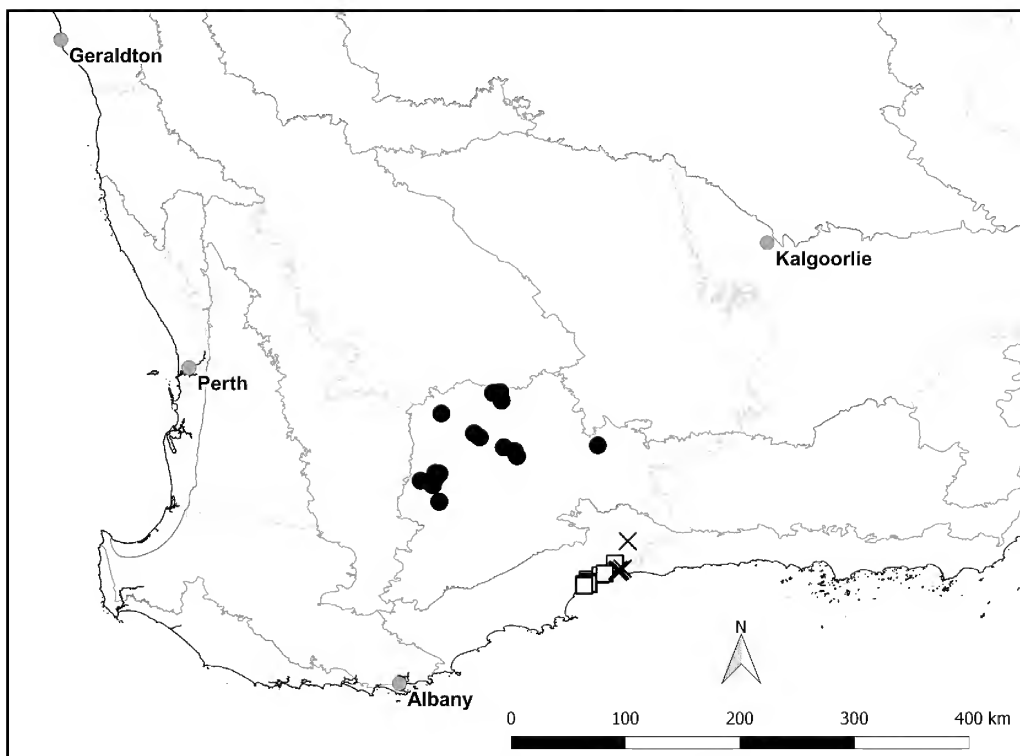


Figure 2. Distribution of *Anticoryne diosmoides* (□), *A. melanosperma* (●) and *A. ovalifolia* (×).

lower branches of *A. ovalifolia* may also be long and narrow. The margins of both kinds of leaves on *A. ovalifolia* have coarse laciniae, which are absent in *A. diosmoides*. Floral differences are also obvious between the two taxa, especially differences in their sepals and stamen numbers as used in the key.

***Anticoryne melanosperma* Rye, *sp. nov.***

*Typus*: Hyden–Narembeen road, Western Australia [precise locality withheld for conservation reasons], 16 October 1975, G. Perry 520 (*holo*: PERTH 04367200; *iso*: CANB, K, MEL).

*Baeckea* sp. Hyden (J.M. Brown 141), G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 348 (2000); Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 25 October 2016].

*Shrub* 0.2–1 m high, the only width record being 0.5 m; flowering branchlets with 1–5 or more pairs of flowers, which tend to form a globular terminal cluster, with the uppermost leaves rather bract-like. *Petioles* 0.3–0.6 mm long. *Leaf blades* ± oblong in outline, 3–6 mm long, 1–1.8 mm wide, 0.6–1 mm thick, with keel thickened especially towards apex, green, entire or with coarse laciniae up to 0.1 mm long, the apical point (when present) up to 0.2 mm long; abaxial surface deeply convex to more shallowly angled, often furrowed along the midvein and with sloping, flatter sides, with oil glands in c. 4 main rows on each side of the midvein; adaxial surface concave to slightly convex. *Peduncles* ± absent. *Bracteoles* broadly ovate to broadly elliptic, 2.5–4.5 mm long, with the broad

scarious margin reddish (becoming brown when dried). *Pedicels* 1.3–2.5 mm long. *Flowers* 10–14 mm diam. *Hypanthium* 1.3–2.3 mm long, 4–4.5 mm diam.; free portion 0.8–1 mm long. *Sepals* depressed-ovate, 1.5–2.5 mm long, 4–4.5 mm wide, deep pink with a white or pink border, entire, very obtuse, not ridged. *Petals* 4–5 mm long, white. *Stamens* 14–25, in a continuous circle (with the bases of the filaments abutting each other or separated by a gap that is much narrower than the filaments) the longest ones antipetalous. *Longest filaments* 1.7–2.5 mm long, the broadest ones 0.5–0.6 mm wide at base. *Anthers* broadly and irregularly obovoid, 0.5–0.6 mm long, c. 0.5 mm wide. *Ovary* 1/2 to largely superior; ovules 4–9 per loculus. *Style* 2–3 mm long; stigma c. 0.2 mm diam. *Fruits* largely superior, 2.5–3 mm long, c. 4 mm diam. *Seeds* ± reniform, 1–1.3 mm long, 0.6–0.7 mm wide, 0.7–0.8 mm thick, shortly tuberculate; hilum 0.2–0.3 mm diam.

*Diagnostic features.* Distinguished from the other species of *Anticoryne* by its thicker leaves, ± absent peduncles, ± reniform seeds with a shortly tuberculate outer surface, and usually fewer ovules.

*Selected specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 Sep. 1990, B. & B. Backhouse s.n. (PERTH 01454331); 26 Oct. 2005, A.M. Coates 5006 (NSW, PERTH); 15 Oct. 1984, E.J. Croxford 3898 (PERTH); 18 Nov. 2007, T. Erickson TEE 230 (PERTH); 20 Oct. 1999, K. Kershaw 2003 (AD, BRI, PERTH); 11 Aug. 1976, B.G. Muir 305 (2.1) (PERTH); 13 Oct. 1963, K. Newbey 1055 (PERTH).

*Distribution and habitat.* Extends from north-west of Hyden south to Dongolocking Reserve and east to near Forrestania (Figure 2), on sandplains, in sand over laterite or rarely associated with granite.

*Phenology.* Flowers are recorded from July to November and mature fruits from October to November.

*Conservation status.* Listed by Smith (2017) as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *Baeckea* sp. Hyden (J.M. Brown 141). The recorded range for *A. melanosperma* extends c. 125 km from north to south and 140 km from west to east.

*Etymology.* From the Greek *melano-* (black, very dark) and *-spermus* (-seeded). The dark colour of the seeds is an unusual character within the *Hysterobaeckea* group of genera and therefore useful in defining the genus *Anticoryne*.

*Notes.* This species is well separated both morphologically and geographically from the other two species of *Anticoryne* (see key above). Its seeds are similar in colour to those of the other two species but differ in being more or less reniform and tuberculate; in most respects they resemble seeds of some species of *Rinzia* Schauer, a genus in which ant-dispersal is apparently common (see Rye 2017). They lack an aril but the relatively large hilum might contain some fleshy material. The hilum is coloured white, contrasting with the very dark testa, as is the aril of most *Rinzia* species.

***Anticoryne ovalifolia*** (F.Muell.) Rye, in B.L. Rye & M.E. Trudgen, *Nuytsia* 22: 393 (2012). *Harmogia ovalifolia* F.Muell., *Fragm.* 2: 32 (1860). *Baeckea ovalifolia* (F.Muell.) F.Muell., *Fragm.* 4: 72 (1864). *Babingtonia ovalifolia* (F.Muell.) F.Muell., *Fragm.* 4: 74 (1864). *Type:* East Mt Barren Range, Western Australia, 1848–1860, G. Maxwell 407 (*lecto*, here designated: MEL 72889; possible *isolecto*: MEL 76240).

*Illustration.* M.G. Corrick, B.A. Fuhrer & A.S. George, *Wildflowers Southern W. Austral.* Figure 430 (1996) [as *Baeckea ovalifolia*].

*Shrub* erect, open, 0.4–1.8 m high, 0.35–1.5 m wide; flowering branchlets with usually 1–7 pairs of flowers. *Petioles* 0.2–0.6 mm long. *Leaf blades* often somewhat recurved in distal half, narrowly ovate to very broadly obovate, 3–8 mm long, 2–4 mm wide, thin, green or silvery, with coarse laciniae up to 0.2 mm long around the margin, acute to broadly obtuse, without an apical point; abaxial surface convex, with oil glands in 3–5 main rows on each side of the midvein; adaxial surface concave except towards apex. *Peduncles* 3–7 mm long. *Bracteoles* ovate to narrowly obovate, tending to be loosely folded, 2.5–4 mm long. *Pedicels* 2.5–5 mm long. *Flowers* 11–15 mm diam. *Hypanthium* c. 2 mm long, 3–4 mm wide; free portion c. 0.5 mm long. *Sepals* very depressed-ovate, 1.1–1.6 mm long, 2.5–3 mm wide, green on the strongly ridged base, the remainder deep pink to pink-purple below a broad white margin or deeply coloured throughout. *Petals* 4–6 mm long, white. *Stamens* 12–17, in an irregular circle or in antisepalous groups of 2–4 opposite the sepals, in the latter case sometimes with 1 or 2 almost directly opposite petals, usually with some gaps between the stamens that exceed the width of the filaments. *Longest filaments* 1–1.6 mm long, the broadest ones 0.25–0.4 mm wide at base. *Anthers*  $\pm$  broadly ovoid, c. 0.4 mm long, c. 0.35 mm wide. *Ovary* largely inferior; ovules 6–10 per loculus. *Style* 2.2–3 mm long; stigma less than 0.2 mm diam. *Fruits* 1/2–2/3 superior, 2.2–2.8 mm long, 3–4 mm diam. *Seeds* strongly faceted, 0.9–1.3 mm long, 0.5–0.7 mm wide, 0.6–0.8 mm thick, minutely colliculate, shiny; hilum not exceeding 0.1 mm diam. (Figure 3)

*Diagnostic features.* Distinguished from the other species of *Anticoryne* by its more lacinate, often broader leaves, more widely spaced stamens, and more ovoid anthers.



Figure 3. *Anticoryne ovalifolia* flowers. Image taken by Peter Rye (voucher B.L. Rye BLR 279045).

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 28 Oct. 1963, *T.E.H. Aplin* 2715 a (PERTH); 12 Jan. 1979, *B. Barnsley* 549 (CBG); 18 Oct. 1964, *C.A. Gardner* 14883 (AD, BRI, PERTH); 26 Nov. 1931, *C.A. Gardner & W.E. Blackall* 1422 (PERTH); 12 Oct. 1989, *P. Hodan* 126 (PERTH); 25 May 1983, *G.J. Keighery* 6098 (KPBG, PERTH); 5 Aug. 1974, *G. Perry* 102 (CANB, NSW, PERTH); 18 Sep. 2007, *B.L. Rye* BLR 279045 (MEL, PERTH); 25 Aug. 1982, *N.G. Walsh* 1037 (PERTH); 9 Aug. 2003, *Peter G. Wilson* 1642 & *G.M. Towler* (PERTH).

*Distribution and habitat.* Occurs in the far south-east of Fitzgerald River National Park, with an isolated record (*G.J. Keighery* 6098) from north-east of the park (Figure 2), recorded mainly on rocky quartzite slopes with *Banksia* dominant, also recorded in near-coastal heath on granite and with mallees on greenstone.

*Phenology.* Flowers mainly from August to November and mature fruits recorded mainly from October to December.

*Conservation status.* Department of Parks and Wildlife Conservation Codes for Western Australian Flora: Priority Two (Smith 2017). This species appears to be highly restricted, occurring naturally only on or within a few kilometres of one of the highest peaks, assuming the isolated record (see above) is an introduction.

*Typification.* Two MEL sheets of this species were examined. While they are sufficiently similar to have been part of the same gathering, only one of them, MEL 72889, is annotated by Mueller with the locality ‘East Mount Barren Range’ and the name *Harmogia ovalifolia*. This sheet, which also bears Maxwell’s collection label, is therefore selected as the lectotype. The other sheet, MEL 76240, which is annotated by Mueller as ‘Baeckea S.W. Australia Maxwell’ is treated as a possible isolectotype.

*Notes.* The basal branchlets of seedlings sometimes have more or less linear leaves. Young plants have their lower branchlets densely covered by much narrower leaves than those found on the flowering branchlets.

See the notes under *A. diosmoides* for a comparison with that species.

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## ***Calandrinia holtumii* (Portulacaceae), a new and unusual species from arid Western Australia**

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### **Abstract**

Obbens, F.J., Hancock, L.P., Edwards, E. & Thiele, K.R. *Calandrinia holtumii* (Portulacaceae), a new and unusual species from arid Western Australia. *Nuytsia* 28: 217–223 (2017). A new species of *Calandrinia* Kunth., *C. holtumii* Obbens & L.P.Hancock, from arid Western Australia is described and mapped. At this stage, the sectional placement for *C. holtumii* is uncertain. It has several anomalous morphological characters not previously recorded within the genus and has recently been shown to exhibit a stronger form of Crassulacean Acid Metabolism (CAM) than any other Australian species of *Calandrinia*.

### **Introduction**

This paper is the latest in a series of papers (e.g. Obbens 2011, 2012) describing endemic species of *Calandrinia* Kunth. in Western Australia. *Calandrinia holtumii* Obbens & L.P.Hancock *sp. nov.*, described here, has several anomalous morphological characters (see *Diagnostic features*) and exhibits a stronger form of Crassulacean Acid Metabolism (CAM) than any other Australian species of *Calandrinia*. It is widespread within the Eremaean Botanical Province of Western Australia.

### **Methods**

Methods used are as described in Obbens (2011). In *C. holtumii* it is impossible to discern between stems and scapes, as also seen in *C. umbelliformis* Obbens in which the length of the stem and scape was measured as one unit referred to as the stem/scape shoot (Obbens 2012). In this paper, the length of the stem, scape and inflorescence axis are measured as one unit along the main axis of the shoot and referred to as the flowering shoot.

The bioregions referred to in describing species distributions and indicated on the map are from the *Interim Biogeographical Regionalisation for Australia (IBRA) Version 7.0* (Department of the Environment 2013).

## Taxonomy

***Calandrinia holtumii*** Obbens & L.P.Hancock, *sp. nov.*

*Type:* Mulla Mulla Flat, Coolcalalaya Road, Shire of Mullewa, along the road from Coolcalalaya Homestead to Yallalong Homestead, c. 17.7 km west-south-west of the New Forest Yallalong Road junction, Western Australia, 6 October 2004, *F. Hort, J. Hort & J. Shanks* 2349 (*holo:* PERTH 06873928; *iso:* AD, CANB, MEL).

*Calandrinia* sp. Black angular seeds (A.A. Mitchell PRP 1661), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed June 2016].

Prostrate to  $\pm$  decumbent *annual herbs*, 5–30 mm tall, 40–230 mm wide, glabrous, the root system comprising a weak taproot with several lateral roots. *Basal leaves* succulent, narrowly spatulate to spatulate, 7.7–16.5 mm long, 1.9–5.2 mm wide at widest point, usually somewhat withered upon flowering and more so by fruiting. *Flowering shoots* usually 5–11, 27–210 mm long, radiating from base, the proximal 5–48 mm leafless, thereafter leafy and branched several times with secondary branching relatively common, each branch terminating in an inflorescence. *Stem leaves* succulent, broadly elliptic to orbicular in outline (3D-shape resembling kidney or jellybeans and also small spheres), occasionally obovate in outline, 2.5–10.3 mm long, 1.4–6.1 mm wide, sessile, alternate, somewhat stem-clasping, terete or semi-terete in T.S., rarely somewhat flattened, mucronate at apex, mostly green becoming reddish brown with age, but some scattered leaves are colourless, translucent, swollen and vesicular; upper leaves on adult plants grading into inflorescence bracts, occasionally with leaf vesicles as above. *Inflorescences* 3–7-flowered; axis 10–90 mm long; bracts 1.4–7.2 mm long, 1.3–4.8 mm wide, succulent, the lower ones broadly semi-orbicular to reniform, auriculate to stem-clasping, often with a mucro at apex, the upper ones broadly triangular, with up to 3 adjoining triangular lobes wrapping around a stem, somewhat scarious when young, but becoming broader, more succulent and leaf-like as the axis continues to grow. *Pedicels* 2.5–10 mm long (to 15 mm long in fruit), erect. *Flowers* 5–8.5 mm diam. *Sepals* thick, broadly ovate to orbicular, 2.1–3.6 mm long, 2.1–3.4 mm wide, free to base, apex obtuse and somewhat cucullate, venation not prominent. *Petals* 5, creamy white tinged with pink or fully mid-pink, broadly elliptic to broadly ovate, rarely broadly obovate, 2.2–4.8 mm long, 1.5–3.4 mm wide, free to base. *Stamens* 10, in one row, alternating short and long; filaments free, 0.6–2.3 mm long, attached to the top of a relatively wide basal ring beneath ovary; lower portion of filament not papillose, but top of basal ring with several rows of transparent, non-glandular, clavate hairs; anthers purple to pink before anthesis, broadly oblong to occasionally elliptic in outline, 0.6–1.8 mm long, 0.4–0.8 mm wide, versatile, extrorse, dehiscent longitudinally. *Ovary* broadly obovoid, 1.1–1.9 mm diam., brown. *Stigmas* 3, becoming narrowly triangular to linear upon maturity, 0.9–1.9 mm long, free to base, with a dense covering of moderately long stigma trichomes. *Capsule* ovoid to broadly ovoid, 2.1–3.2 mm long, 1.3–2.8 mm wide, usually protruding beyond the sepals at maturity; apex obtuse; valves 3, splitting at the summit at first, extending to 2/3 the length of the capsule with age. *Seeds* 55–134 per capsule, black, glossy, globular or ‘tear-drop’ shaped with a relatively flattened base, trigonous in section, often angular and faceted when not fully developed, surface nearly smooth (although obscurely colliculate at high magnification), 0.3–0.4 mm long, 0.25–0.35 mm wide, 0.2–0.3 mm thick. (Figures 1, 2)

*Diagnostic features.* *Calandrinia holtumii* may be uniquely diagnosed within the genus by the unusual swollen, translucent, vesicular, modified leaves scattered amongst normal photosynthetic ones, by the succulent, auriculate to stem-clasping inflorescence bracts, and by the smooth staminal filaments and basal androecial ring surmounted by rows of clavate hairs.

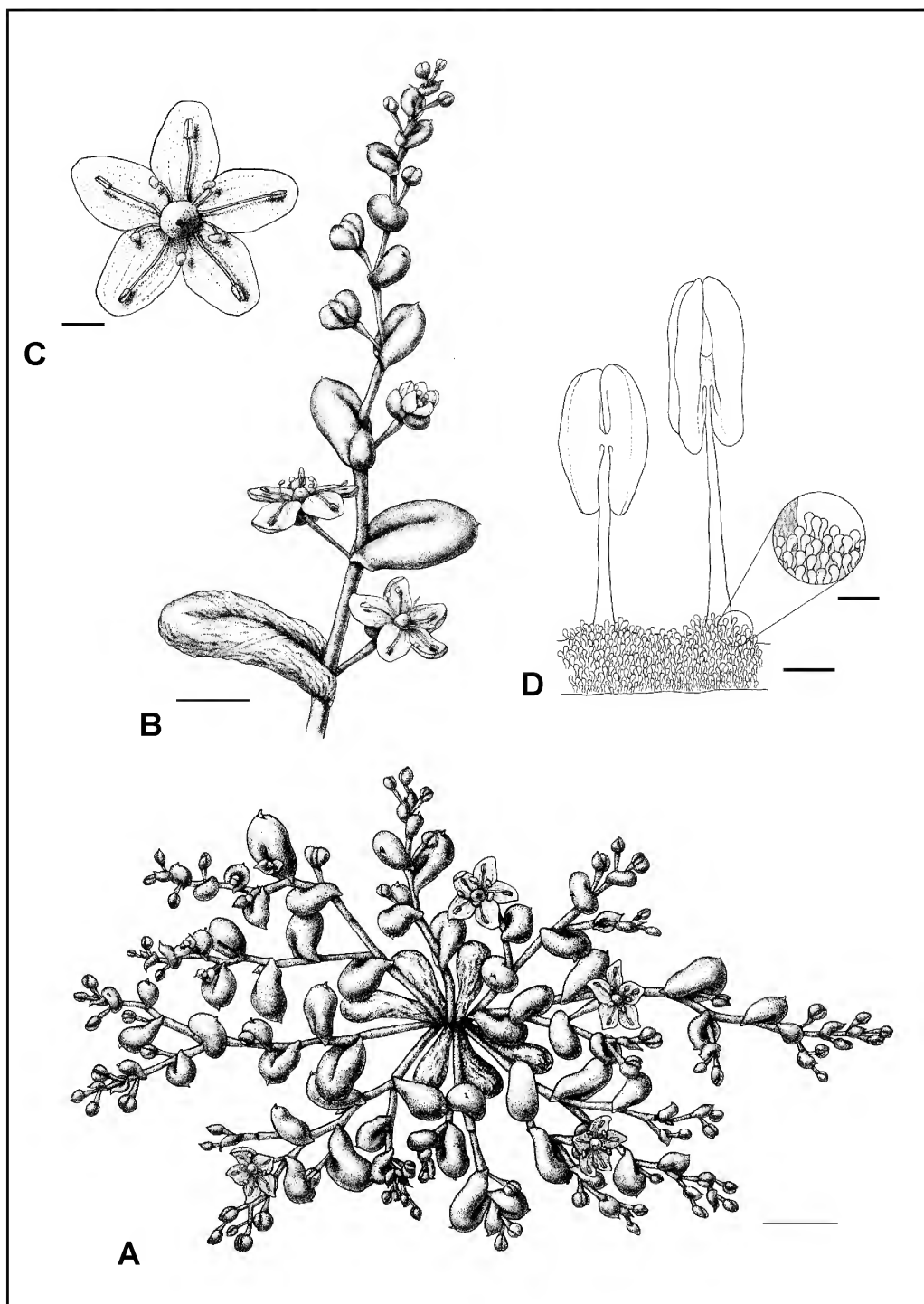


Figure 1. *Calandrinia holtumii*. A – habit; B – branchlet; C – flower; D – stamens, the magnified portion showing the unusual clavate hairs on the androecial ring. Scale bars = 1 cm (A); 5 mm (B); 1 mm (C); 400µm (D); 100 µm (D inset). Illustration by Elissa Johnson.

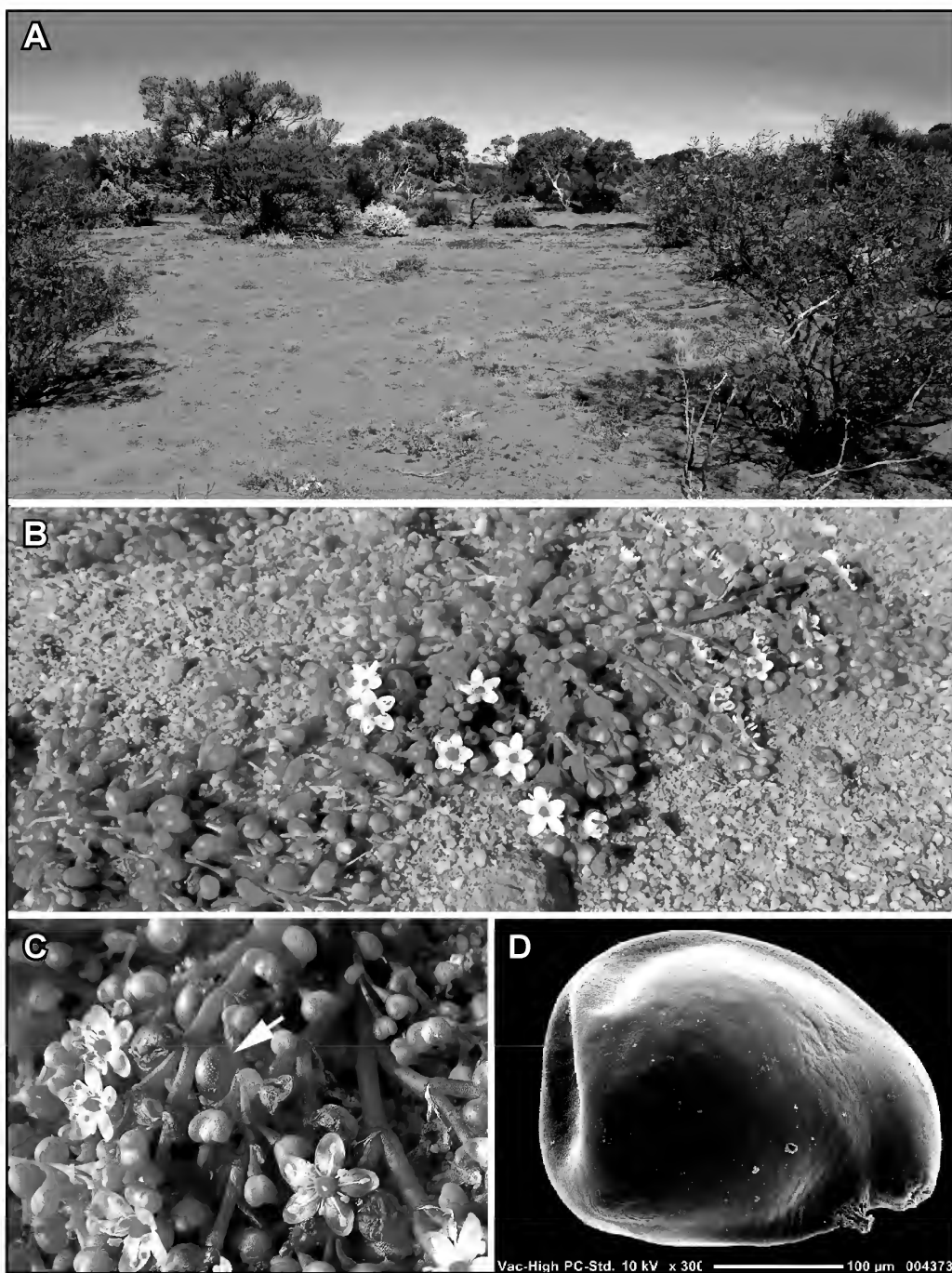


Figure 2. *Calandrinia holtumii*. A – habitat; B – habit, with translucent vesicular leaves indicated by an arrow; C – plan view of a well-developed seed. Photographs © Jean Hort (A–C), and Frank Obbens and Russell Barrett (D). Image voucher populations *F. Obbens, F. Hort & J. Hort* FO 10/08 (A); *F. Hort, J. Hort & J. Shanks* 2346 (B & C); *F. Hort, J. Hort & J. Shanks* 2349 (D).

*Other specimens examined.* WESTERNAUSTRALIA: mine flats, Paraburdoo, 29 Sep. 1979, *K. Atkins* 598 (PERTH); 2.4 km N of Salt Bore on Lake Way station, 12.8 km NW of homestead, 34.2 km SSE of Wiluna, 23 Sep. 2005, *P. Armstrong* PA 05/508 (PERTH); Mulla Mulla Flat, Coolcalalaya Rd, Mullewa, along road from Coolcalalaya Homestead to Yallalong Homestead, c. 20.4 km WSW of New Forest Yallalong Rd or c. 18.6 km ENE of Natural Gas Pipeline, 6 Oct. 2004, *F. Hort, J. Hort & J. Shanks* 2346 (PERTH); on Waldburg Station, upper Gascoyne River area, c. 65 km SE of Mount Augustus Station homestead, 17 Oct. 2004, *M. Lee & M. Strelein s.n.* (PERTH); 15.1 km from Red Hill Station near Onslow, on bearing of 240 deg., Site I424, 16 Sep. 1996, *A.A. Mitchell* PRP 1661 (PERTH); 80.2 km NE along the Dooley Downs–Pingandy Rd from Mt Augustus Homestead, 20 Sep. 2013, *F. Obbens & R. Davis* FO 7/13 (PERTH); 48.9 km along the Dalgety Downs–Landor Rd from junction with the Landor–Mt Augustus Rd, 22 Sep. 2013, *F. Obbens & R. Davis* FO 11/13 (PERTH); along Butchers Track 25.7 km E of where gas pipeline crosses track and also c. 93 km E of the North West Coastal Hwy, 19 Aug. 2008, *F. Obbens, F. Hort & J. Hort* FO 10/08 (PERTH); 29.2 km N of Murchison Settlement on the Carnarvon–Mullewa Rd (W side of road), 19 Aug. 2008, *F. Obbens, F. Hort & J. Hort* FO 16/08 (PERTH); 54.5 km W along the Byro–Woodleigh Rd from the junction with the Carnarvon–Mullewa Rd, just past the turnoff to Ballythunna Homestead, 12 Oct. 2011, *F. Obbens & G. Marsh* FO 13/11 (PERTH).

*Phenology.* Flowers and fruits from mid-August to mid-October.

*Distribution and habitat.* *Calandrinia holtumii* is widespread in the Yalgoo, Murchison, Gascoyne and Pilbara bioregions (Figure 3). It is probably under-collected and is likely to occur in adjacent parts of the Carnarvon and Little Sandy Desert bioregions. It occurs mostly on plains sometimes adjacent to drainage lines and claypans, rarely on gibber flats and lower scree slopes of mesas, on red-brown sandy loams or sandy clay loams sometimes with surface stones and quartz. Most sites are open shrublands or herbfields with one site described as low open shrubs with samphire. Associated species across its wide range include: *Acacia aneura*, *A. acuaria*, *A. ?citrinoviridis*, *A. grasbyi*, *Aristida contorta*, *Angianthus* sp., *Atriplex holocarpa*, *Brachyscome* sp., *Calandrinia remota*, *Eragrostis dielsii*, *Eremaea cremulata*, *E. phylloda*, *Goodenia tenuiloba*, *Gummiopsis rodwayii*, *Maireana carnosae*, *M. georgei*, *Ptilotus polakii*, *Senna glutinosa* subsp. *glutinosa*, *Sida calyxhymenia*, *Triodia longiceps* and *T. wiseana*.

*Conservation status.* *Calandrinia holtumii* is represented at PERTH by 11 collections distributed over a range of approximately 650 × 550 km. Only one collection is from a conservation reserve, with most occurring on either pastoral or mining leases or Unallocated Crown Land. Although poorly collected, *C. holtumii* is not considered to be under threat.

*Etymology.* The epithet honours Prof. Joseph Holtum of James Cook University, Townsville, Australia, who has pioneered research on CAM photosynthesis including work within the Australian flora (e.g. Holtum & Winter 1999; Winter & Holtum 2014).

*Affinities.* The affinities of *C. holtumii* are uncertain, although it shows similarities in habit to a few other species. Both *C. holtumii* and *C. umbelliformis* have a prostrate habit comprising several radiating stems, each stem with the proximal part bare, but thereafter much-branched and with numerous broadly elliptic to orbicular leaves somewhat reminiscent of jellybeans and small spheres in 3D-shape. *Calandrinia creethiae* Morrison is also prostrate and has similar (although often longer) leaves, but it differs in having four-valved rather than three-valved capsules. All three species co-occur on flats at Coolcalalaya Station. *Calandrinia holtumii* and *C. umbelliformis* have similar-sized, five-merous flowers, while *C. creethiae* has slightly larger flowers with six or seven petals. *Calandrinia holtumii* consistently has ten stamens while *C. umbelliformis* has 25–35.

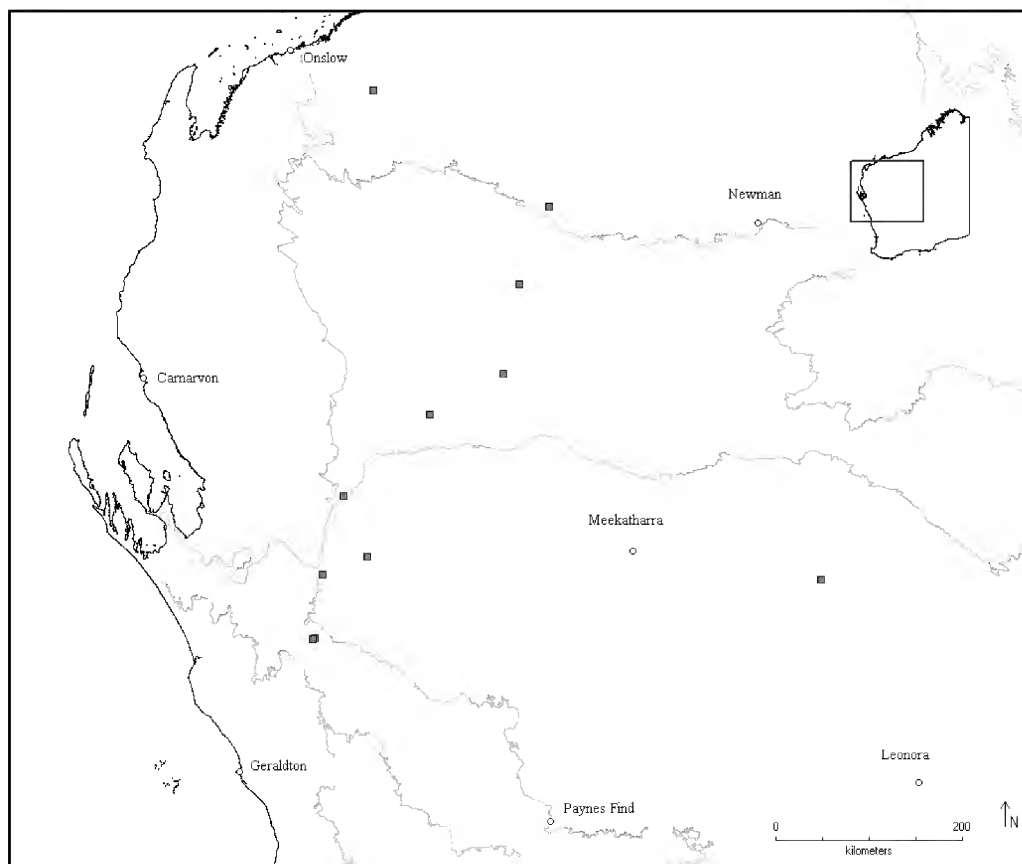


Figure 3. Distribution of *Calandrinia holtumii* in Western Australia.

*Notes.* The two earliest PERTH collections of *C. holtumii* came from the Pilbara region and are relatively poor specimens with limited immature seed; thus, they were labelled as indeterminant. In 2004 better-developed specimens of *C. holtumii* were collected by Fred and Jean Hort and Jim Shanks, from Coolcalalaya Station in the Murchison region. These collections were confirmed as being the same as those from the Pilbara and the phrase-name *C. sp. Black angular seeds* (A.A. Mitchell PRP 1661) was erected on the vascular plant census. Pilbara collections of *C. holtumii* have larger flowers and more elliptical anthers than those from further south, but in all other respects are typical of this taxon.

*Calandrinia holtumii* exhibits the strongest CAM photosynthetic cycle among Australian *Calandrinia* species investigated for CAM activity thus far (L.P. Hancock pers. comm.). CAM photosynthesis improves water use and photosynthetic efficiency in conditions such as drought and high soil salinity (Lutge 1987). It is a complex trait that requires numerous biochemical, anatomical and physiological changes, yet has evolved from the more common  $C_3$  photosynthetic pathway, likely dozens of times (Smith & Winter 1996). While full, constitutive CAM plants utilise CAM most of the time, there are many  $C_3$ -CAM intermediate phenotypes (Cushman 2001; Winter *et al.* 2015), including in *Calandrinia* (Winter & Holtum 2011, 2014; Holtum *et al.* 2017). Recent molecular analyses of *C. holtumii* (L.P. Hancock pers. comm.) indicates that it has a key CAM-specific amino-acid substitution that is lacking in all other tested *Calandrinia* species. This substitution may make its CAM cycle more efficient (L.P. Hancock pers. comm.) and it is possible that *C. holtumii* may represent an incipient origin of ‘full’ constitutive CAM.

### Acknowledgements

We thank Mike Hislop for reviewing an earlier draft of this paper. Our thanks to Elissa Johnson who produced the excellent illustrations for Figure 1. Fred and Jean Hort provided excellent collections and field observations and also provided the images for Figure 2. Rob Davis provided welcome field assistance. Thanks to Russell Barrett, previously at the Botanic Gardens and Parks Authority, Western Australia, for help with the SEM seed images. Many staff, colleagues and volunteers at the Western Australian Herbarium (Department of Parks and Wildlife) helped in some way with this project, including provision of access to facilities at that institution. LPH was supported in part by NSF IGERT grant DGE 0966060.

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## SHORT COMMUNICATION

**A new species of *Chamaescilla* (Asparagaceae) from the mid-west of Western Australia**

***Chamaescilla maculata*** R.W.Davis & A.P.Br., *sp. nov.*

*Type*: [north-west of Northampton,] Western Australia [precise locality withheld for conservation reasons], 2 August 2016, *R.W. Davis* 12624 & *A.P. Brown* (*holo*: PERTH 08785384; *iso*: CANB).

Tuberous perennial *herb*, to 7 cm high. *Tubers* oblong, 6–10 mm long, 2–3 mm diam., white. *Leaves* 5–7 per individual, spreading, forming a basal rosette, linear, 30–40 mm long, 1–2 mm wide, mostly glabrous, occasionally with a few hairs along margins. *Inflorescences* corymbose, comprising 1–3(–6) flowers. *Pedicel* 5.5–9.5 long, subtended by one or sometimes two ovate bracts; bract 1.2–2.3 mm long, reddish green; margins sometimes toothed towards the base. *Perianth segments* spreading, sub-equal, broadly ovate, 3.9–4.5 mm long, 2.9–3.1 mm wide, white to very pale blue with reddish to purple tips mostly on the abaxial surface of the outer perianth whorl, faintly three-nerved. *Stamens* 6, shorter than perianth segments, filaments white, flattened, 1.1–1.3 mm long, 0.19–0.20 mm wide, glabrous; anthers 0.8–0.9 mm long. *Ovary* ovoid to globular, 3-locular, 0.9–1.2 mm long, 1.1–1.3 mm wide, glabrous; ovules 5 or 6 per locule. *Style* level or slightly shorter than anthers, 1.2–1.5 mm long. *Capsule* narrowly ovoid to ellipsoid, 4.7–5.8 mm long, 3.4–4.2 mm wide. *Seed* not seen. (Figure 1B)

*Diagnostic features.* *Chamaescilla maculata* can be distinguished from all other taxa in *Chamaescilla* F.Muell. ex Benth. by having 5–7 leaves per plant, which form a basal rosette; perianth segments 3.9–4.5 mm long, white or sometimes very pale blue, with reddish to purple tips, mostly on the abaxial surface of the outer perianth whorl; 1–6 flowers per scape; and narrowly ovoid to ellipsoid fruit.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 17 Aug. 2016, *R. Davis* 12642 & *R. Simkin* (PERTH); 31 Sep. 1997, *M. Hislop* 928 (PERTH); 15 Sep. 2016, *R. Simkin* RS 104 (PERTH).

*Phenology.* Flowering from mid-winter to late winter; fruiting from late winter to early spring.

*Distribution and habitat.* The new species is currently recorded from two localities, one north-west of Northampton and the other north-east of Jurien Bay (although refer to the *Notes* for information on a possible third population). It occurs in low heath with herbs, in boggy, seasonally wet areas. At the Northampton locality it is associated with *Calytrix depressa*, *Verticordia chrysantha*, *Chamaescilla corymbosa* var. *corymbosa* and *Borya sphaerocephala* (Figure 1D). North-east of Jurien Bay it occurs in open woodland, associated with *Corymbia calophylla*, *Hakea lissocarpa*, *Petrophile seminuda*, *Chamaescilla corymbosa* var. *corymbosa* and *Calothamnus hirsutus*.

*Conservation status.* *Chamaescilla maculata* is to be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (M. Smith pers. comm.). The species is currently known from just two populations, both on private property.



Figure 1. *Chamaescilla maculata*. A – habitat at the type locality; B – solitary flower, showing the characteristic red-purple markings on the tips of the outer perianth segments; C – flower of *C. corymbosa* var. *corymbosa*, from the same population. Images from R. Davis 12624 & A.P. Brown (B) and R. Davis 12643 (C). Photographs by R. Davis.

**Etymology.** The epithet is from the Latin *maculatus* (spotted) in reference to the reddish to purple markings at the ends of the perianth, mostly on the abaxial surface.

**Notes.** We first encountered *C. maculata* in August 2016 when conducting surveys north-west of Northampton, at which time we observed it growing sympatrically with *C. corymbosa* (R.Br.) Benth. var. *corymbosa*. Both taxa also co-occur at the second known locality (M. Hislop 927). *Chamaescilla maculata* differs most obviously from *C. corymbosa* and its included varieties in having a white

perianth with red markings (*cf.* a blue perianth; Figure 1C) and narrowly ovoid to ellipsoid capsules (*cf.* obcordate capsules).

The collection notes for a gathering of *Chamaescilla* sp. from a boggy area in the Moresby Range (*N. McFarland* 1326 & *N. Green*) describe a co-occurring form with a white perianth bearing small reddish markings at the tips of petals on the abaxial surface. We were unable to locate this specimen, but we are reasonably confident that these observations refer to our new species.

The vernacular name Red-Spotted Squill is suggested.

### Acknowledgements

We wish to thank Robin Simkin for supplying site information regarding the new taxon, and Mike Hislop who advised us of his collection from the Jurien Bay population and provided observations.

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## ***Stylidium* miscellany 3: a synopsis of Robert Brown's Stylidiaceae types and occasional notes on associated names**

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### **Abstract**

Wege, J.A. *Stylidium* miscellany 3: a synopsis of Robert Brown's Stylidiaceae types and occasional notes on associated names. *Nuytsia* 28: 229–246 (2017). A synopsis of the 39 species of Stylidiaceae named by Robert Brown is presented and a full synonymy provided. Lectotypes are selected for the following Brown names: *Levenhookia pusilla* R.Br., *Stylidium alsinoides* R.Br., *S. articulatum* R.Br., *S. assimile* R.Br., *S. caespitosum* R.Br., *S. calcaratum* R.Br., *S. corymbosum* R.Br., *S. crassifolium* R.Br., *S. diversifolium* R.Br., *S. eriorhizum* R.Br., *S. fasciculatum* R.Br., *S. floribundum* R.Br., *S. guttatum* R.Br., *S. tenuifolium* R.Br. (= *S. laricifolium* Rich.), *S. luteum* R.Br., *S. pedunculatum* R.Br., *S. reduplicatum* R.Br. (= *S. pilosum* (Labill.) Labill.), *S. spinulosum* R.Br., *S. tenellum* R.Br. (= *S. tenerum* Spreng.) and *S. violaceum* R.Br. *Stylidium robustum* Sond. is newly synonymised under *S. diversifolium* and lectotypes are selected for two additional synonyms of this species, *S. marginatum* Sond. and *S. pruinosum* Sond. *Stylidium pilosum* is lectotypified and a neotype designated for *S. pilosum* var. *brevius* E.Pritz. Comments on the uncertain circumscription of *S. armeria* (Labill.) Labill. (of which *S. melastachys* R.Br. is a synonym) are provided.

### **Introduction**

As the naturalist on board the HMS *Investigator* voyage under the command of Matthew Flinders, Robert Brown's contribution to Australian botany is legendary (Stearn 1960; Mabberley 1985; Vallance *et al.* 2001; Moore 2005) and his research on the triggerplant family Stylidiaceae is no exception. His description of 38 species of *Stylidium* Sw. as part of his *Prodromus* (Brown 1810) remains an extraordinary taxonomic contribution to the genus, which is now known to comprise more than 300 species. He also named and circumscribed the family, which he insightfully defined on the basis of the reduced number of stamens, unique floral column and imbricate aestivation of the corolla lobes (Brown 1810, 1814), and described the genus *Levenhookia* R.Br. based on his collection of *L. pusilla* R.Br.

Twenty-nine of the *Stylidium* species described by Brown occur in south-western Australia, a centre of diversity for the genus. Indeed, the *Investigator* anchorage at King George Sound (Albany) from 8 December 1801 to 5 January 1802 (Vallance *et al.* 2001) was auspicious in terms of *Stylidium*—not only is the greater Albany region an area of high triggerplant diversity, but many species are in flower in this region at this time. This is in stark contrast to many other genera, which are well past their peak spring-flowering period by then (Keighery & Gibson 2005). Brown had ample opportunity to explore and collect plants from a range of habitats and it is a testament to his skills that he managed to collect the majority of species known from the region; almost all of the species that he did not find

were either past flowering or require disturbance to stimulate flowering.

However, Brown was not infallible. Examination of his *Stylidium* types has revealed three clear instances of mixed gatherings or mixed species concepts: *S. scandens* R.Br. comprised separate collections of *S. scandens* and *S. nymphaeum* Wege (Wege 2010), *S. junceum* R.Br. was based on a mixed gathering of *S. junceum*, *S. squamosotuberosum* Carlquist and *S. thryonides* Wege (Wege 2014), and *S. fasciculatum* R.Br. was based on a mixed gathering of *S. fasciculatum* and *S. adnatum* R.Br. (see under *S. fasciculatum* below). It is also possible that his type gathering of *S. articulatum* R.Br. includes a fragment of *S. amoenum* R.Br. (see under *S. articulatum* below).

The following synopsis of Brown's Stylidiaceae names and types is published in preparation of an account of the family for *Flora of Australia* and as an aid in the preparation of a forthcoming publication by David Mabberley and David Moore, which will provide a comprehensive register of Brown's plant names and types (Mabberley & Moore 2007). This paper also provides an opportunity to provide additional taxonomic or typification notes on associated names.

### Methods

For those species based solely on Brown's own collections, the following approach has been adopted. Where only one sheet has been located (i.e. for *S. adnatum*, *S. amoenum*, *S. breviscapum* R.Br., *S. falcatum* R.Br., *S. propinquum* R.Br. and *S. rotundifolium* R.Br.), it is treated as the holotype. These specimens have a blue *Iter Australiense* label (prepared according to the instructions of J. J. Bennett), indicating that they originated from Brown's own herbarium (Mabberley 1985), and in each case they bear Brown's original field labels as well as an annotation by Brown indicating the page number for that taxon in his *Prodromus*.

Where more than one sheet has been found, the material at BM from Brown's own herbarium (as described above) is designated as an appropriate lectotype; invariably these specimens are the best and most complete of the available material. Of these, there are several species (*Levenhookia pusilla*, *S. assimile* R.Br., *S. diversifolium* R.Br., *S. inundatum* R.Br. and *S. reduplicatum* R.Br.) for which the only material known is the lectotype and one or more 'Dryander duplicates' (see explanation in Vallance *et al.* 2001: 14). The Dryander duplicates were unlikely to have used by Brown for his *Prodromus* descriptions, in which case they could be interpreted as isotypes (D.J. Mabberley pers. comm.). However, all material was used to inform Brown's descriptive slips (his plant descriptions made on the expedition and now held at BM) and it remains a possibility that he consulted these slips when compiling his Stylidiaceae account (e.g. for detail concerning the presence or absence of appendages on the corolla lobes and labellum, which can be difficult to see in the dried state).

While Brown's descriptions were based primarily on his own material, three species of *Stylidium* (*S. alsinoides* R.Br., *S. capillare* R.Br. and *S. pedunculatum* R.Br.) were based solely, or in part, on material collected by Joseph Banks and Daniel Solander from Endeavour River (Queensland) in 1770, while *S. despectum* R.Br. was based on a collection made by William Paterson from Tasmania in 1805 (Wege 2011). Only one sheet has been located for both *S. capillare* and *S. despectum* and accordingly they are treated as holotypes. For both *S. alsinoides* and *S. pedunculatum*, the primary specimen in Banks' Herbarium (annotated by Brown) has been designated as the lectotype since it is of better quality than the material that formed part of Brown's 'study set' that he took to Australia, although the latter may also have been used in descriptions made on board *Investigator*.

Notes on lectotypifications of taxa named by authors other than Brown are included under each species.

### Typifications and miscellany

**Levenhookia pusilla** R.Br., *Prodr. Fl. Nov. Holland.* 573 (1810). *Type citation*: ‘(M.) v. v.’ *Type specimen*: near the observatory, Princess Royal Harbour, King George’s Sound [Western Australia], 21 December 1801, *R. Brown s.n.* [Bennett No. 2613] (*lectotype*, here designated: BM 001041273!; *isolectotype*: BM 000948765!).

**Stylidium adnatum** R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Candollea adnata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Goose Island Bay larger island [Middle Island, Western Australia], January 1802, *R. Brown s.n.* [Bennett No. 2611] (*holotype*: BM 000812588!).

*Stylidium propinquum* R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Stylidium adnatum* R.Br. var. *propinquum* (R.Br.) R.Br. in Sims, *Bot. Mag.* 52, t. 2598 (1825). *Stylidium adnatum* var. *abbreviatum* Benth., *Fl. Austral.* 4: 33 (1868), *nom. illeg.*, *nom. superfl.* *Candollea adnata* var. *abbreviata* (Benth.) De Wild., *Icon. Horti Then.* 2: 9, t. 43 (1901), *nom. illeg.* *Type citation*: ‘(M.) v. v.’ *Type specimen*: King George’s Sound [Western Australia], December 1801–January 1802, *R. Brown s.n.* [Bennett No. 2612] (*holotype*: BM 000812587!).

*Notes.* The holotype of *S. adnatum* is a single, fairly robust individual with numerous stems that arise from a lignotuberous stock. This species, which is widespread in southern Western Australia (Western Australian Herbarium 1998–), is usually geophytic, with plants dying back to a lignotuber over the dry, summer months and resprouting following autumn rains. Occasionally, the above-ground stems persist (presumably if there is sufficient water available over summer), with the apical stem node giving rise to new shoots and occasionally adventitious roots. Apical shoots are evident in the left hand individual on the holotype of *S. propinquum*; material that differs further from the holotype of *S. adnatum* in having shorter and narrower stems and, for the most part, shorter scapes with fewer flowers. Brown later treated this taxon as variety of *S. adnatum*, noting the two forms share an ovary that is sterile in one loculus (Sims 1825). Although Brown’s variety was recognised by Erickson (1958), the illegitimate name *S. adnatum* var. *abbreviatum* has been inexplicably used in Western Australia for many years (Paczkowska & Chapman 2000; Western Australian Herbarium 1998–). *Stylidium adnatum* is a variable species in terms of its habit and overall robustness (e.g. stem length and width, inflorescence length and flower number) and var. *propinquum* is not worth recognising.

**Stylidium alsinoides** R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Candollea alsinoides* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(T.) B. v. s.’ *Type specimen*: Endeavour River [Queensland, June–August], 1770, *J. Banks & D. Solander s.n.* (*lectotype*, here designated: BM 000645715!; *isolectotypes*: BM 001041266! [study set], NSW 133570 *n.v.*).

*Typification.* Prior to 1 January 2001, if an author stated that a particular specimen was the holotype of a previously published name but other specimens of the cited gathering existed, then this was an error to be corrected to lectotype (see McNeill 2014); however, Bean’s (2000: 635) citation ‘holo: ?BM *n.v.*’ cannot be corrected in this manner since there are two Banks and Solander duplicates housed at BM (neither of which were seen or annotated by Bean).

**Stylidium amoenum** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea amoena* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2592] (*holotype*: BM 000903578!).

*Notes.* Refer to the notes under *S. articulatum* regarding material of *S. amoenum* on the CANB isoelectotype of that species.

**Stylidium armeria** (Labill.) Labill., *Nov. Holl. Pl. Spec.* 2: 66, t. 216 (1806). *Candollea armeria* Labill., *Ann. Mus. Hist. Nat.* 6: 455 (1805). *Type*: ‘Habitat in capite van-Diemen’ [May 1792, J.J.H. de Labillardière s.n.] (*syntypes*: BM 000894111! [individuals labelled ‘B’], B-W 17048-010 image!, FI 006811!, G 00354007!, G-DC G 00493487 image!, ?MPU 016343 image!).

*Stylidium melastachys* R.Br., *Prodr. Fl. Nov. Holland.* 568 (1810). *Type citation*: ‘(D.) v. v.’ *Type specimen*: Kent’s Group, Bass Strait, December 1803, R. Brown s.n. [Bennett No. 2577] (*lectotype* *fide* E.J. Raulings & P.Y. Ladiges, *Austral. Syst. Bot.* 14(6): 929 (2001): BM 000603724!; *isoelectotypes*: BM 000603725!, DBN n.v., E 00279234!, E 00279235!, E 00279236!, K 000060478!, MEL 2257703!, MEL 2257704!, MEL 2257705!, P 00712398 image!).

*Stylidium dilatatum* W.D.Jacks. & R.J.E.Wiltshire, *Austral. Syst. Bot.* 14(6): 961, 964, 965 (2001). *Type*: ridge west of Proctors Road, opposite The Lea, Tasmania (*holotype*: HO 22793!; *isotypes*: BM n.v., HO 22790!, MEL 2330860 image!).

*Typification.* Lectotypification of *S. armeria* should only be considered once the taxonomy of the *S. graminifolium* Sw. complex is resolved (see notes below). All duplicates of Labillardière’s gathering are therefore treated here as syntypes regardless of how they are annotated or databased. Note that FI 006811, which I have mistakenly annotated as the holotype, bears extensive annotations by Labillardière. My annotation slip on this specimen should read ‘flowering specimens possess two broad channels of stomata on lower [not upper] surface and lack stomata on upper [not lower] surface’. I also observed stomata towards the apex of the upper leaf surface in the fruiting individual that is second from the left.

*Notes.* *Stylidium armeria*—a species from the widespread and morphologically variable south-eastern Australian *S. graminifolium* complex—was simultaneously reinstated by Jackson and Wiltshire (2001) and Raulings and Ladiges (2001), albeit with differing circumscriptions (both studies treated Brown’s *S. melastachys* as a synonym). It is not my aim here to provide a comprehensive commentary on the discrepancies within and differences between these two publications, nor a solution to the taxonomic confusion that has been created by their publication. This group of triggerplants (which, in addition to the taxa referred to herein, includes the New South Wales endemic *S. productum* Hindm. & Blaxell) exhibits complex patterns of morphological and ecological variation and I have limited field knowledge of them so far. Moreover, I have made only a cursory examination of a fraction of the specimens available for study in Australian herbaria. The following brief summary simply serves to highlight some of the taxonomic issues that need resolving and the scope of research that will need to be conducted in order to do so.

The study by Jackson and Wiltshire (2001), which had a Tasmanian focus, redefined *S. graminifolium* as a diploid species ( $n = 15$ ,  $2n = 30$ ) widespread on infertile soils or sites of high evapotranspirational stress in summer and autumn, and characterised by narrow (1 to almost 3 mm wide), bifurrowed leaves. They describe its frequent parapatric distribution in Tasmania with broader-leaved, tetraploid cytotypes ( $2n = 60$ ) that favour fertile soils or sites of low evapotranspiration. The study by Raulings and Ladiges (2001), which had a Victorian focus and did not investigate ploidy levels, similarly delineated *S. graminifolium* as a species from sandy habitats with narrow (1–2.5 mm wide), bifurrowed leaves. The leaves of the broader-leaved forms (variously described as *S. armeria*, *S. dilatatum* or *S. montanum* Raulings & Ladiges) were described in both studies as >3 mm wide and flat in section.

While at first glance these studies appear to be in broad agreement with respect to the circumscription of *S. graminifolium*, there are some significant discrepancies, not limited to the following three examples. Firstly, Raulings and Ladiges (2001) consider the regular serrations on the leaf margins to be taxonomically informative, with the broad-leaved forms either having smooth margins or occasional serrations that are mostly confined to near the tip; however, Jackson and Wiltshire (2001), state that this feature is taxonomically unreliable, describing *S. graminifolium* as variably serrulate, with the margins sometimes smooth or serrulate near the apex. Secondly, scape width is described by Raulings and Ladiges as >2 mm and diagnostic with respect to *S. montanum* (<2 mm wide) but not *S. armeria* (>2 mm), whereas Jackson and Wiltshire describe it as narrower (mean 1.5 mm; upper scape *c.* 1 mm) and diagnostic with respect to *S. dilatatum* (mean 3.2 mm; upper scape *c.* 2 mm) and *S. armeria* (mean 4.4 mm; upper scape *c.* 4 mm wide). Thirdly, Raulings and Ladiges consider throat appendage morphology (specifically the reduced size of the anterior-most appendages) as a useful character upon which to separate *S. graminifolium* from *S. armeria* (but not *S. montanum*), but Jackson and Wiltshire state that throat appendage morphology is uninformative.

The two studies differ even further with respect to the broader-leaved forms (leaves >3mm wide). Jackson and Wiltshire (2001) recognised two tetraploid species, *S. armeria s. str.* and *S. dilatatum*, the former restricted to littoral habitats of highly exposed coasts in Tasmania and on islands of the Bass Strait (and ‘probably extending to about Twofold Bay in NSW’), and the latter widespread in more inland areas of south-eastern Australia and Tasmania. They were differentiated by leaf shape (spathulate in *S. armeria s. str.* and linear in *S. dilatatum*) and stomata distribution (confined to the lower leaf surface in *S. armeria s. str.* and present on both surfaces in *S. dilatatum*), with the flowers of *S. armeria s. str.* noted to be *c.* 20% larger (although measurement ranges were not provided for either species). Additional diagnostic information for *S. dilatatum* was mostly provided with respect to *S. graminifolium* and consequently taxonomic placement of broad-leaved herbarium specimens has proven difficult (Gray 2011). Of note is the contradictory information given by Jackson and Wiltshire with respect to the distribution of stomata in *S. armeria s. str.* (e.g. the description on p. 960 indicates stomata can in fact be present on the upper leaf surface) and the existence of collections from well outside the cited geographic range of *S. armeria s. str.* which appear to lack stomata on the upper leaf surface (e.g. *Hj. Eichler* 14634, Bogong High Plains, CANB).

The broad-leaved form was broadly circumscribed by Raulings and Ladiges (2001) under *S. armeria*, with the exception of *S. montanum*, a species they recognised from subalpine and alpine habitats in Victoria, New South Wales and Tasmania that grows in close proximity to *S. armeria* on the Bogong High Plains and at Mt Buffalo. *Stylidium montanum* was said to be characterised by its relatively short, pale to mid-green leaves (4–15 cm long *cf.* 15–40 cm and dark green in *S. armeria*), shorter, narrower scapes (10–45 cm high and 2 mm wide *cf.* 50–100 cm high and >2 mm wide in *S. armeria*) with fewer flowers (10–30 *cf.* (25–)30–100 in *S. armeria*) and a sparser indumentum (glabrous or glabrescent below the lowest flower *cf.* glandular-hairy below the lowest flower in *S. armeria*). Jackson and Wiltshire (2001), who were aware of the taxonomic studies being conducted by Raulings as part of her PhD dissertation, refer to *S. montanum* on p. 953 (as *Stylidium sp. nov.*) and suggest that it is a tetraploid ( $2n = 60$ ) and does not occur in Tasmania. Since no specimens of *S. montanum* from Tasmania were cited by Raulings and Ladiges, it is not recognised in that state (Council of Heads of Australasian Herbaria 2011a).

In Tasmania, *S. armeria* and *S. dilatatum* are considered insufficiently distinct to warrant recognition of the latter species (Gray 2011). A broad concept of *S. armeria* is also followed in Victoria, where Best *et al.* (2009) described a Critically Endangered subspecies, *S. armeria* subsp. *pilosifolium* R.J. Best, D.E. Francis & N.G. Walsh, with eglandular and glandular hairs on both leaf surfaces. In preparation for

a treatment of Stylidiaceae for *Flora of South Australia*, I have applied Raulings and Ladiges' broad concept of *S. armeria* to South Australian material at AD; however, I did not have time to examine their holdings of this complex from other states. Indeed, there are a significant number of collections at AD, CANB and NSW that have not been formally assessed.

I recently conducted a very preliminary sort of material at CANB which indicated that there is considerably more variation in this species complex than has been accounted for in either study. The reliability of leaf width to separate *S. graminifolium* (<3 mm) from *S. armeria* s. lat. and *S. montanum* (>3 mm) must be questioned in view of the significant number of specimens that intergrade. These include specimens with leaves <3 mm that otherwise have features considered by one or both studies as characteristic of *S. armeria* or *S. montanum* (e.g. leaves flat in T.S., leaf margin entire, corolla lobes large, anterior-most throat appendages conspicuous and column very long). Jackson and Wiltshire (2001) describe a higher density of smaller stomata in *S. graminifolium* s. str. as compared with the polyploidy species *S. armeria* and *S. dilatatum*, a feature that could perhaps inform taxonomic work if *S. armeria* s. lat. is indeed polyploid throughout its range, but this must also be questioned in view of recent ecological studies of *S. armeria* s. lat. that have indicated populations in alpine Victoria are diploid (Hoffman *et al.* 2009).

While both Raulings and Ladiges (2001) and Jackson and Wiltshire (2001) make insightful observations at a local scale, resolution of the taxonomy of the *S. graminifolium* complex demands a geographically comprehensive, modern and integrative approach that uses multiple lines of evidence (molecular, morphological, cytological and ecological) and includes examination and curation of the more than 2,500 specimens currently available in Australian herbaria. This is not something that I will be able to pursue from Western Australia.

**Stylidium articulatum** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea articulata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(M.) v. v.' *Type specimens*: King George's Sound [Western Australia], 3 January 1801, *R. Brown s.n.* [Bennett No. 2593] (*lectotype*, here designated: BM 000903579!; *isoelectotypes*: BM 001041332!, CANB 279057! [right hand individual], E 00279199!, E 00279200!, K 000060586!, K 000060587!). ?*Paralectotype* [*syntype*]: King George's Sound [Western Australia], 3 January 1801, *R. Brown s.n.* (CANB 279057! [left hand individual]), = *S. amoenum* R.Br.

*Typification*. CANB 279057 consists of a complete individual of *S. articulatum* on the right hand side together with a fragment of *S. amoenum*. It is unclear whether the latter is type material of *S. amoenum* (due to an error that has occurred post-*Prodromus*) or indeed whether Brown made a mixed gathering. I have observed both species growing in close proximity east of Albany suggesting the latter is not beyond the realms of possibility.

**Stylidium assimile** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea assimilis* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882), *nom. illeg. non* Steud. (1845 = a name of uncertain application in Dilleniaceae). *Type citation*: '(M.) v. v.' *Type specimen*: Princess Royal Harbour, King George's Sound [Western Australia], December 1801–January 1802, *R. Brown s.n.* [Bennett No. 2584] (*lectotype*, here designated: BM 000797560!; *isoelectotype*: BM 000797561!).

**Stylidium breviscapum** R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Candollea breviscapa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: Bay I South Coast [Lucky Bay, Cape Le Grand, Western Australia, January 1802], *R. Brown s.n.* [Bennett No. 2608] (*holotype*: BM 001041346!).

*Stylidium breviscapum* var. *erythrocalyx* Benth., *Fl. Austral.* 4: 31 (1868). *Type*: ‘S West end Cape arid Range’ [Western Australia], *s. dat.*, *G. Maxwell s.n.* (*lectotype fide* J.A. Wege, *Nuytsia* 20: 80 (2010): MEL 2046601!; *isolectotype*: K 000060836!). *Paralectotype* [*syntype*]: Fitzgerald Ranges, *s. dat.*, *G. Maxwell* 150 (BM!, MEL 672624!), = *S. involucrellum* F.Muell.

***Stylidium caespitosum*** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea caespitosa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Princess Royal Harbour, King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2582] (*lectotype*, here designated: BM 000797556!; *isolectotypes*: BM 000797555! CANB 279058!, E 00279194!, E 00279195!, E 00279196!, FI 006806, K 000060801!, K 000060857!, MEL 0259383!, P 00712385!).

***Stylidium calcaratum*** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea calcarata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Princess Royal Harbour, King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2598] (*lectotype*, here designated: BM 000645735!; *isolectotypes*: BM 000645736!, E 00279218!, FI 006805!, K 000060137!, K 000060139!, P 00712386!).

*Stylidium mimeticum* Lowrie & Carlquist, *Phytologia* 71(1): 16 (1991), *syn. nov.* *Type*: In sand, along Great Northern Highway north of Bullsbrook, 1 km south of Wandena Road (south end) on east side of the Highway, Western Australia, 3 December 1989, *Allen Lowrie* 243 (*holotype*: PERTH 01643126!; *isotypes*: PERTH 01643118!, RSA *n.v.*).

*Notes*. Examination of the floral column in type material of *S. calcaratum* at BM and K has revealed a minute, obtuse appendage on the bend identical to that described for the later-named *S. mimeticum* (see Lowrie & Carlquist 1991: 19, Figure 7F), leading me to regard the latter as a conspecific (Western Australian Herbarium 1998–). My revision of *S. calcaratum* and allies (subg. *Centridium* Lindl.) is in an advanced stage of preparation and seeks to resolve the taxonomy of this group across Australia.

***Stylidium capillare*** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea capillaris* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(T.) B v. s.’ *Type specimen*: Endeavour River, New Holland [Queensland, June–August] 1770, *J. Banks & D. Solander s.n.* (*holotype*: BM 000563895!).

*Stylidium quadrifurcatum* F.L.Erickson & J.H.Willis, *Vict. Naturalist* 73: 5 (1956), *syn. fide* A.R. Bean, *Austrobaileya* 5(4): 620 (2000). *Type*: Pine Creek, Northern Territory, April 1904, *J.H. Niemann s.n.* (*holotype*: MEL 1061651!).

***Stylidium corymbosum*** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea corymbosa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: South Coast Bay 1 [Lucky Bay, Western Australia], January 1802, *R. Brown s.n.* [Bennett No. 2602] (*lectotype*, here designated: BM 000603873!; *isolectotypes*: BM 000603874!, E 00279182!, E 00279183!, K 000060777!, K 000060778!).

***Stylidium crassifolium*** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea crassifolia* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Princess Royal Harbour, King George’s Sound [Western Australia], December 1802 [*sic*; 1801], *R. Brown s.n.* [Bennett No. 2601] (*lectotype*, here designated: BM 001041312!; *isolectotypes*: CANB 279059!, E 00279259!).

*Stylidium leptobotrys* DC., *Prodr.* 7(2): 783 (1839). *Stylidium leptobotrydium* St.-Lag., *Ann. Soc. Bot. Lyon* 7: 135 (1880), *nom. illeg.*, *nom. superfl.* Type: ‘in Novâ-Hollandiâ ad Swan-river’ [Western Australia, 1835–1838], *J. Drummond s.n.* (holotype: G-DC G 00458493!; *isotypes*: BM 000812571!, FI 006802, ?G 00358766!, ?K 000060346!, K 000060351!).

*Dampiera inundata* de Vriese, in Lehm., *Pl. Preiss.* 1(3): 404 (1845). Type: ‘In subturfosis hieme aqua inundatis planitie prope urbiculam Albany, Plantagenet [Western Australia], d. 29 m. Jan. 1840. Herb. Preiss. No. 1523’ (*syn*: L 0001767 image!, L 0843043 image!, LD 1043796!).

*Notes.* L 0001767 is labelled as the lectotype of *Dampiera inundata* and L 0843043 as an isotype but to my knowledge no lectotypification has been published.

**Stylidium despectum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea despecta* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). Type citation: ‘(D.) v. s.’ Type specimen: Port Dalrymple [George Town, Tasmania], 1805, *W. Paterson s.n.* (holotype: BM 000645719!).

*Stylidium brachyphyllum* Sond., in Lehm., *Pl. Preiss.* 1(3): 386 (1845). *Candollea brachyphylla* (Sond.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). Type: In solo turfoso ad Princess Royal Harbour [Albany, Western Australia], December 1840, *L. Preiss* 2239 (lectotype *fide* J.A. Wege, *Austral. Syst. Bot.* 24: 384 (2011): MEL 2069492!; *isolectotypes*: G 00354009!, LD 1751955!, P 00712379!, TCD! [as *L. Preiss* 453]). *Paralectotype* [*syntype*]: In depressis uliginosis silvae prope oppidulum, Perth [Western Australia], 26 September 1839, *L. Preiss* 2248 (BR 0000005422593 image!, FI 113175!, G 00354004!, G 00354006!, G 00354008!, L 0001764 image!, L 0001765 image!, LD 1097540!, M 0175802!, MEL 2069490!, MEL 2069491!, MO-797443 image!, P 00712380!, W!).

**Stylidium diffusum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea diffusa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). Type citation: ‘(T.) v. v.’ Type specimen: Shoal water bay [Queensland], 1802–1805 [3 September 1802], *R. Brown s.n.* [Bennett No. 2605] (lectotype *fide* A.R. Bean, *Austrobaileya* 5(4): 627 (2000): BM 000563899!; *isolectotypes*: E 00279231!, K 000060550!).

*Typification.* Bean’s (2000: 627) type citation for *S. diffusum* (‘holo: BM’) is corrected herein to reflect his inadvertent lectotypification (see McNeill 2014).

**Stylidium diversifolium** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea diversifolia* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). Type citation: ‘(M.) v. v.’ Type specimen: King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2594] (lectotype, here designated: BM 000903576!; *isolectotypes*: BM 001041333!, BM 001041334!).

*Stylidium robustum* Sond., in Lehm., *Pl. Preiss.* 1(3): 378 (1845), *syn. nov.* Type: In arenosis districtus Sussex [Western Australia], 22 December 1839, *L. Preiss* 2235 (*syn*: LD 1745623!, MEL 293341!, MEL 2235239!).

*Stylidium marginatum* Sond., in Lehm., *Pl. Preiss.* 1(3): 379 (1845). Type specimens: In arenosis colliculosis silvae prope oppidulum Guildford [Western Australia], 13 September 1839, *L. Preiss* 2232 (lectotype, here designated: MEL 2258906! [Sheet 1 of 2], MEL 2258907! [Sheet 2 of 2]; *isolectotypes*: G 00358783!, G 00358784!, L 0001773 image!, LD 1753748!, MO-797518 image!, P 00712392!, W! [2 sheets]); Swan River [Western Australia, 1841], *J. Drummond* 529 (*paralectotypes* [*syntypes*]: BM 000903577!, K 000060680!, K 000060684!, MEL 2258911! P 03025123!, W! [2 sheets]).

*Stylidium pruinolum* Sond., in Lehm., *Pl. Preiss.* 1(3): 379 (1845). *Type*: In subturfosis hieme inundatis haud longe a Kaudiup, Plantagenet [Western Australia], 24 November 1840, L. Preiss 2236 (*lectotype*, here designated: MEL 2258905!; *isolectotypes*: BR 0000005422555 image!, G-DC G00358785!, G 00358786!, G 00358787!, GOET 011204 image!, LD 1731539!, M 0175794!, MEL 2258903!, MEL 2258904!, MO-797526 image!, P 00712393! W! [2 sheets]).

*Typification.* Mildbraed (1908) was correct to place both *S. marginatum* and *S. pruinolum* in the synonymy of *S. diversifolium*, although he failed to consider *S. robustum*, which is added to the synonymy presented herein. Sonder examined all of the known type material of *S. robustum*, of which LD 1745623 and MEL 293341 both comprise an individual in fruit while MEL 2235239 consists of three dissected corollas and columns. The two MEL sheets are from Sonder's personal herbarium and it is of note that the tip of the inflorescence of the fruiting specimen is missing. It is therefore possible that flowers were once present on this specimen but were dissected by Sonder, the fragments of which were placed in a packet (subsequently mounted on MEL 2235239 together with a label bearing diagnostic information in Sonder's hand). However, there remains an element of uncertainty with this interpretation and as such the three specimens are best regarded as syntypes.

Of the syntypes listed above for *S. marginatum*, Sonder examined and annotated the Preiss material at MEL and LD as well as the Drummond material at BM. The MEL material (MEL 2258906 and MEL 2258907), which is from Sonder's personal herbarium, is designated as an appropriate *lectotype*: the former sheet includes a single individual with an incomplete inflorescence, descriptive information in Sonder's hand, and dissected flowers in a packet, and the latter sheet is a complete individual (albeit with a broken scape).

I have seen several sheets of the type gathering of *S. pruinolum* but only three of these have been annotated by Sonder: MEL 2258904, MEL 2258905 and LD 1731539. MEL 2258905, which includes descriptive annotations by Sonder and dissected flowers fragments in a packet, is herein designated as the *lectotype*.

MEL 2069493 is from Sonder's personal herbarium and comprises a single, incomplete individual of *S. diversifolium* and two labels, one for Preiss 2232 (the type of *S. marginatum*) and the other for Preiss 2236 (the type of *S. pruinolum*). I am uncertain as to which gathering this specimen came from.

*Notes.* *Stylidium diversifolium* exhibits variation in overall robustness, leaf size and shape, hyaline leaf margin morphology (whether erose, fimbriate or entire), the number of whorls of sterile scape bracts, the presence of labellum lateral appendages and glandular trichome density, which accounts for Sonder's (1845) somewhat enthusiastic taxonomy.

***Stylidium eriorhizum*** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea eriorhiza* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(T.) v. v.' *Type specimen*: Shoalwater Bay Thirsty Sound outer and inner entrance [Queensland], 3 September 1802, R. Brown s.n. [Bennett No. 2586] (*lectotype*, here designated: BM 000645731!; *isolectotypes*: BM 000645732!, E 00279213!, E 00279214!, FI 006824, K 000060209!, K 000060212!, MEL 2257317!, NSW 923303 image!, P 00712394 image!, P 00712395 image!).

*Typification.* Bean's (1999a) citation 'holo: BM' is not treated herein as an inadvertent *lectotypification* since he did not indicate which of the two duplicates at BM was the 'holotype' (neither duplicate has been annotated by Bean).

**Stylidium falcatum** R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Candollea falcata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: King George’s Sound [Western Australia, December 1801–January 1802], *R. Brown s.n.* [Bennett No. 2610] (*holotype*: BM 000812589!).

*Stylidium lessonii* DC., *Prodr.* 7(2): 337 (1839). *Type*: ‘in Novâ Hollandiâ ad portum Regis Georgii legit cl. Lesson. ... (v.s. comm. à cl. Mérat.)’ (*holotype*: G-DC G00458499!; *isotype*: P 00313107!).

*Stylidium falcatum* f. *robusta* Wawra, *Itin. Princ. S. Coburgi* 1: 131 (1883). *Type*: King George’s Sound [Western Australia], 1872–1873, *H. Wawra* Coll. I 854 [cited as 845 in protologue] (*holotype*: W!).

**Stylidium fasciculatum** R.Br., *Prodr. Fl. Nov. Holland.* 572 (1810). *Candollea fasciculata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882), *nom. illeg. non* R.Br. ex DC. (1817 = *Hibbertia depressa* Steud., Dilleniaceae). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Bald Head, King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2609] (*lectotype*, here designated: BM 000812593!; *isolectotypes*: BM 000812582!, BM 000812592!, CANB 279060!, E 00279240!, E 00279263!, E 00279264!, K 00060329!, MEL 2254211!). *Paralectotype* [*syntype*]: King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2609] (BM 000812591), = *S. adnatum*.

*Notes*. Brown describes the capsules of *S. fasciculatum* as having seeds in both loculi. While this is evident in the bulk of the material cited above, only one fertile locule is evident in the three fragments which comprise BM 000812591 (mounted on the lower right hand side of the sheet that also bears BM 000812593 and BM 000812582). This anomalous material is labelled by Brown as ‘*Stylidium fasciculatum* β’ and is referable to *S. adnatum*.

*Stylidium fasciculatum* is a morphologically variable species that is the subject of ongoing taxonomic investigations that aim, in part, to resolve the status of *S. fasciculatum* subsp. *gigantic* (J.A. Wege JAW 1174) (Western Australian Herbarium 1998–) and *S. fasciculatum* var. *elongatum* Benth., the latter of which is a name of uncertain application (Council of Heads of Australasian Herbaria 2011b).

**Stylidium floribundum** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea floribunda* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(T.) v. v.’ *Type specimen*: North Coast Carpentaria Island h [North Island, Northern Territory], 20 December 1802, *R. Brown s.n.* [Bennett No. 2588] (*lectotype*, here designated: BM 000563896!; *isolectotypes*: BM 000563900!, E 00279265!, E 00279266!, E 00279267!, K 000741770!, K 000741771!, MEL 1061579!, P 00712396!).

*Typification*. Bean’s (1999b) citation ‘holo: BM (2 sheets)’ is not considered herein as an inadvertent lectotypification since the two sheets are duplicates and not a single specimen (BM 000563896 is the specimen from Brown’s own herbarium while BM 000563900 is the Dryander duplicate).

**Stylidium glandulosum** Salisb., *Parad. Lond.* 2(1), t. 77 (1807). *Stylidium fruticosum* R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810), *nom. illeg., nom. superfl.* *Candollea glandulosa* (Salisb.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘Sponte nascentem in *New Holland*, oris occidentalibus, legit R<sup>us</sup> BROWN. ... For this species, Mr. Hooker is indebted to E.J.A. WOODFORD, Esq. I saw it in flower at Kew, in July, 1804...’ (?*holotype*: K 000355286!).

*Notes*. Peter Good collected seeds of *S. glandulosum* in January 1802 whilst *Investigator* was anchored

at Lucky Bay. It subsequently became one of the first triggerplants to be grown in Europe, with records indicating it was in cultivation at Kew by 1803 (Aiton 1814, as *S. fruticosum*). It was here in 1804, prior to Brown's return to Australia, that Richard Salisbury examined flowering material, publishing the species three years later in *Paradisus Londinensis*, a work that described and illustrated plants cultivated in the vicinity of London.

Salisbury was a controversial character and his hostile relationship with Brown is well documented (Mabberley 1985). Upon naming *S. glandulosum*, he falsely claimed that Brown had collected only fruiting material and it seems likely that he simply could not resist providing an account of a new species that belonged to a little known genus which had 'excited a considerable degree of curiosity' and become 'the subject of much conversation' (Salisbury 1807). Salisbury's description is accompanied by a plate by William Hooker (1779–1832), a botanical artist employed by the Horticultural Society of London (Stafleu & Cowan 1979). Ferdinand Bauer also illustrated *S. glandulosum*. His field drawing is labelled as *S. adnatum* in Pignatti-Wikus *et al.* (2000: 99, No. 23) but identifiable as *S. glandulosum* on account of its inflorescence structure and the ellipsoid, densely glandular-hairy hypanthia.

I have located two specimens of note: K 000355286, which is annotated 'Hort' in an unknown hand and has been mounted on a sheet alongside duplicates of Brown's gathering of this species; and BM 000797474, which bears an annotation on the reverse of sheet that reads 'Hort. Kew (N. Holl. Pet. Good) 1805'. Since fragments of Salisbury's herbarium are known to be at K (David Mabberley pers. comm.), the former is treated herein as a possible holotype.

Note I have mistakenly annotated Brown's collections of *S. glandulosum* at BM, E, K and P as type material of *S. fruticosum*; *S. fruticosum* is automatically typified by the type of *S. glandulosum*, a name Brown clearly did not want to adopt (Brown 1810: 570).

**Stylidium guttatum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea guttata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 85 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: inter Princess Royal Harbour and Cape How[e], King George's Sound [Western Australia], 25 December 1801, *R. Brown s.n.* [Bennett No. 2607] (*lectotype*, here designated: BM 001041255!; *isolectotypes*: BM 001041256!, E 00279210!, FI 006820!, K 000060204!, P 00712399!).

*Stylidium androsaceum* DC., *Prodr.* 7(2): 783 (late Dec. 1839), *nom. illeg., non* Lindl. (1 Dec. 1839). *Type*: 'in Novâ-Hollandiâ ad Swan-river' [Western Australia, 1835–1838], *J. Drummond s.n.* (*holotype*: G-DC G 00458462!; *isotypes*: BM 001041254!, CGE!, FI 006821!, FI 006822!, G 00358797!, K 000060206!).

**Stylidium hirsutum** R.Br., *Prodr. Fl. Nov. Holland.* 568 (1810). *Candollea hirsuta* (R.Br.) F.Muell., *Syst. Census Austral. Pl.* 85 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: King George's Sound [Western Australia], 9 December 1801, *R. Brown s.n.* [Bennett No. 2676] (*lectotype fide* J.A. Wege, *Nuytsia* 16(1): 194 (2006): BM 000797546!; *isolectotypes*: BM 000797547!, CANB 279061!, E 00279186!, E 00279187!, FI 006817! K 000060258!, K 000741806!, MEL 2156094!, P 00712400!, P 00712401 image!).

**Stylidium inundatum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Type citation*: '(M.) v. v.' *Type specimen*: near the observatory eastern shore of Princess Royal Harbour, King George's Sound [Western Australia], December 1801–January 1802, *R. Brown s.n.* [Bennett No. 2603] (*lectotype fide* J.A. Wege, *Austral. Syst. Bot.* 24: 388 (2011): BM 000645713!; *isolectotype*: BM 000645714!).

*Stylidium sidjamesii* Lowrie & Kenneally, *Nuytsia* 13(2): 296 (2000). *Type*: along Great Northern Hwy North of Bullsbrook, 1 km S of Wandena Rd (S end) on East side of highway, Western Australia, 9 November 1991, A. Lowrie 494 (*holotype*: PERTH 05584957!; *isotypes*: MEL 2295044 image!, PERTH 08231575!).

***Stylidium junceum*** R.Br., *Prodr. Fl. Nov. Holland.*: 569 (1810). *Candollea juncea* (R.Br.) F.Muell., *Syst. Cens. Austral. Pl.*: 85 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: Princess Royal Harbour, King George’s Sound [Western Australia], December 1801, R. Brown *s.n.* [Bennett No. 2598] (*lectotype fide* J.A. Wege, *Nuytsia* 24: 228 (2014): BM 000812596! [the 3 individuals with numerous scapes]; *isolectotypes*: BM 000812596! [left hand individual], K 000060236! [right hand individual]). *Paralectotypes* [*syntypes*]: BM 000812584! [left hand individual], E 00208675!, E 00208676!, FI 006814!, K 000355053! [left hand individuals and scape fragment], = *S. thryonides* Wege; BM 000812596! [scape fragments either side of the 3 lectotype individuals], BM 000812584! [central fragment and right hand individual], K 000355053!, P 00313152!, = *S. squamosotuberosum* Carlquist; DBN *n.v.*

*Stylidium junceum* var. *brevius* E.Pritz., in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 591 (1905); *S. junceum* var. *brevior* orth. var., Mildbr. in Engl., *Pflanzenr.* IV. 278 (Heft 35): 51 (1908); *S. junceum* subsp. *brevius* (E.Pritz.) Carlquist, *Aliso* 7(1): 32 (1969). *Type citation*: ‘in solo aridior, e. gr. in dunis arenoso-calcareis ad ostium fluminis Swan River flor. m. Nov. et in distr. Stirling pr. Albany in silvis arenoso-glareosis.’ *Type specimens*: [not cited; given by J. Mildbraed, *op. cit.* 53 as ‘West-Australien: Distr. Stirling: S. Plantagenet nördlich von Albany, in niedrigen auf Kiesboden’, 15 November 1901, L. Diels 5521] (*syn*: B *n.v.*, destroyed in WWII). *Neotype fide* J.A. Wege, *Nuytsia* 24: 228 (2014): Chester Pass Road, south boundary of Stirling Range National Park, Western Australia, 13 October 2011, J.A. Wege & C. Wilkins JAW 1867 (*neotype*: PERTH 08541000; *isoneotypes*: CANB 826715.1, MEL 2389097).

***Stylidium laricifolium*** Rich., in Pers. *Syn. Pl.* 2: 210 (1806). *Candollea laricifolia* (Rich.) F.Muell., *Syst. Cens. Austral. Pl.*: 86 (1882). *Type citation*: ‘in Novae Hollandia s. Australasia’ [Sydney, New South Wales, probably gathered on the Baudin expedition] (*syn*: MPU 016340 image!, P 00712402!, P 00712403!).

*Stylidium tenuifolium* R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Type citation*: ‘(J.) v. v.’ *Type specimen*: near rivers Hawkesbury and Grose, Port Jackson [Sydney, New South Wales], R. Brown *s.n.* [Bennett No. 2597] (*lectotype*, here designated: BM 000645741!; *isolectotypes*: BM 000645745!, E 00279285!, K 000060167!, K 000060172!, MEL 2257733!, MEL 2257734!, NSW 658012 image!).

*Notes*. Three germane specimens of *S. laricifolium* have been found, two of them from Louis Claude Richard’s personal herbarium, which reached P via the Drake del Castillo collection. A third specimen (MPU 016340), annotated as being from ‘Port Jackson (Nouv. Hollande)’ and interpreted as likely duplicate material, is from the herbarium of Jacques Cambessèdes, who received the collection from Adrien de Jussieu in 1833. Jussieu (1811) wrote at length on the floral morphology and systematic placement of *Stylidium* in an article that included an illustration of *S. laricifolium* drawn by Richard. The type of *S. laricifolium* is most likely to have been collected on Baudin’s 1800–1804 expedition to New Holland with *Géographe* and *Naturaliste*, which included a visit to Port Jackson (Sydney) from June to November 1802.

**Stylidium luteum** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea lutea* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: King George’s Sound [Western Australia], 19 December 1801, *R. Brown s.n.* [Bennett No. 2591] (*lectotype*, here designated: BM 000797552!; *isolectotypes*: BM 000797553!, CANB 279062!, K 000060708!).

**Stylidium pedunculatum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea pedunculata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882), *nom. illeg. non* R.Br. ex DC. (1817 = *Hibbertia endlicheri* F.Muell., Dilleniaceae). *Type citation*: ‘(T.) B. v. s.’ *Type specimen*: Endeavour River [Queensland], 1770, *J. Banks & D. Solander s.n.* (*lectotype*, here designated: BM 000645707!; *isolectotypes*: BM 001041267! [study set], L 0001774 image!, NSW 133569 *n.v.*).

*Stylidium bryoides* F.Muell., *Fragm.* 6: 91 (1867). *Type*: Rockingham Bay [Queensland], 24 October 1867, *J. Dallachy s.n.* (*syn*: K 000060557!, MEL 1061535 image!).

*Stylidium curtum* Carlquist, *Aliso* 9: 421 (1979). *Type*: Wilderness Trail, 6.8 [7] km from Park Headquarters, between Lily Pond Trail turnoff and Smith’s Rock Trail turnoff, Katherine Gorge National Park, Northern Territory, 24 June 1978, *S. Carlquist* 15467 (*holotype*: RSA 283549!; *isotypes*: BRI AQ0334694 image!, DNA D0017924 image!, K 000355244!, PERTH 01640968!, US 00147149 image!).

*Typification*. Bean (2000: 617) did not view the two Banks and Solander duplicates of *S. pedunculatum* housed at BM. His citation ‘holo: ?BM *n.v.*; iso: L’ is not treated herein as an inadvertent lectotypification since a specific specimen is not cited.

I have located two syntypes of *S. bryoides*: MEL 1061535 and K 000060557, both of which were viewed by Bentham for *Flora Australiensis* (Bentham 1868) immediately after the species was named by Mueller. Both sheets bear annotations by Mueller and are congruent with his description, although only the K sheet is annotated as *S. bryoides*.

**Stylidium piliferum** R.Br., *Prodr. Fl. Nov. Holland.*: 569 (1810). *Candollea pilifera* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2583] (*lectotype fide* J.A. Wege, *Nuytsia* 20: 85 (2010): BM 000894110!; *isolectotypes*: BM 001041325!, E 00279189!, K 000060745!).

*Stylidium piliferum* var. *minor* Mildbr., in Engl. *Pflanzenr.* IV. 278 (Heft 35): 71 (1908). *Stylidium piliferum* subsp. *minor* (Mildbr.) Carlquist, *Aliso* 7(1): 40 (1969). *Type*: King George’s Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2583] (*lectotype fide* J.A. Wege, *Nuytsia* 20: 86 (2010): BM 000894110!; *isolectotypes*: BM 001041325!, E 00279189!, K 000060745!). *Paralectotype [syntype]*: Kent, Hammersley River [Western Australia], October 1901, *L. Diels* 4931 (B *n.v.*, destroyed in WWII).

*Stylidium saxifragoides* Lindl., *Sketch Veg. Swan R.* xxviii (1839). *Type*: not cited [Swan River, Western Australia, 1835–1838, *J. Drummond s.n.* (*syntypes*: CGE!, K 000060754!); Swan River [Western Australia], 1831, *Capt. J. Mangles s.n.* (*syntype*: CGE!)].

*Notes*. I previously overlooked the material collected by Mangles on the type sheet of *S. saxifragoides* at CGE (Wege 2010); the citation for this name has been updated accordingly.

**Stylidium pilosum** (Labill.) Labill., *Nov. Holl. Spec. Plant.* 2: 63, t. 213 (1806). *Candollea pilosa* Labill., *Ann. Mus. Hist. Nat.* 6: 453, t. 3 (1805). *Stylidium longifolium* Rich., in Pers. *Syn. Pl.* 2: 210 (1806), *nom. illeg.*, *nom. superfl.* *Type*: ‘Habitat in terrâ Van-Leuwin’ [Esperance Bay, Western Australia, 13–18 December 1792, J.J.H. Labillardière s.n.] (*syn*: FI 006836!, FI 006834!, FI 006835!, G 00358824!, P 00313114!).

*Stylidium reduplicatum* R.Br., *Prodr. Fl. Nov. Holland.* 568 (1810). *Candollea reduplicata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 85 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: South Coast Bay 1 [Lucky Bay, Western Australia], 12 January 1802, R. Brown s.n. [Bennett No. 2575] (*lectotype*, here designated: BM 000603857!; *isolectotype*: BM 000603858!).

*Stylidium dicksonii* Hort. ex Loudon, *Suppl. Hort. Brit.* [Loudon] 645 (1850), *nom. inval.*, *pro syn.* [name cited in synonymy under *S. pilosum*].

*Stylidium pilosum* var. *brevius* E.Pritz., in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 589 (1905); *S. pilosum* var. *brevior* orth. var., Mildbr. in Engl., *Pflanzenr.* IV. 278 (Heft 35): 80 (1908). *Type citation*: ‘in distr. Eyre pr. Esperance in collibus graniticis sublitoralibus corolla rosea flor. m Nov. (D. 5372)’ (*holo*: B n.v., destroyed in WWII). *Neotype*: near carpark at Rossiter Bay, Cape Le Grand National Park, Western Australia, 20 October 2003, J.A. Wege & C. Wilkins JAW 997 (*neotype*, here designated: PERTH 06957277; *isoneotype*: CANB, MEL).

*Notes*. Labillardière’s collection of *S. pilosum* from Esperance Bay was the first triggerplant to be collected from Western Australia. Five sheets from this gathering have been found and are cited here as syntypes. Of the specimens at FI, FI 006836 and FI 006834 are labelled ex Herb. Labillardière; the former is a fruiting collection that features extensive descriptive annotations by Labillardière, while the latter bears both flowers and fruits but is not annotated by Labillardière. FI 006835, also with flowers and fruits, is labelled ex Herb. Desfontaines, bears an annotation by Labillardière in the lower right hand corner and, of all the syntypes, appears to be the best match for the illustration that appears in the original publication.

The holotype of *S. pilosum* var. *brevius* was destroyed in WWII and no duplicates are known; a neotype is designated to fix the application of this name as a synonym of *S. pilosum*. Pritzel’s recognition of this variety has its roots in the misapplication of the name *S. pilosum*, initially by Brown (1810; to material of *S. plantagineum* Sond.), and subsequently by Sonder (1845; to material of *S. affine* Sond.) and Bentham (1868; to material of *S. plantagineum*, *S. affine* and *S. albomontis* Carlquist). Mildbraed (1908) did not examine type material of *S. pilosum* and was unable to apply the name, treating *S. pilosum* var. *brevius* as a synonym of *S. reduplicatum*. The true identity of *S. pilosum* was resolved by Willis (1956).

**Stylidium pygmaeum** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea pygmaea* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v. v.’ *Type specimen*: near the eastern shore of Princess Royal Harbour, King George’s Sound [Western Australia], 16 December 1801, R. Brown s.n. [Bennett No. 2604] (*lectotype fide* J.A. Wege, *Austral. Syst. Bot.* 24: 393 (2011): BM 001041264! [2 individuals on top left hand corner of sheet]; *isolectotypes*: BM 001041264! [individual mounted on top right hand corner, individual to the right of the Andrews label]).

*Stylidium exoglossum* F.L.Erickson & J.H.Willis, *Muelleria* 1(1): 11 (1956). *Type*: swamps c. 2 miles west of Albany aerodrome, Western Australia, 13 January 1953, R. Erickson s.n. (*holotype*: MEL

2295770A! [left hand specimen]; *isotypes*: K 000355212!, PERTH 02945630!, PERTH 01641034!, PERTH 01641042!).

**Stylidium repens** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea repens* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 85 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: King George's Sound, Western Australia, 18 December 1801, *R. Brown s.n.* [Bennett No. 2606] (*lectotype fide* A. Lowrie, A.H. Burbidge & K.F. Kenneally, *Nuytsia* 13(1): 139 (1999): BM 001041257!; *isolectotypes*: BM 001041258!, E 00279208!, E 00279209!, FI 006829!, K 000741762! K 000741764!, MEL 0672618!, MEL 2156138!, MEL 2156139!, NSW 830769!, P 00712420!, P 00712421!).

*Stylidium radicans* Sond., in Lehm., *Pl. Preiss.* 1(3): 381 (1845). *Type*: 'arenosis subumbrosis prope oppidulum Perth' [Western Australia], 16 June 1839, *L. Preiss* 2300 (*lectotype fide* A. Lowrie, A.H. Burbidge & K.F. Kenneally, *Nuytsia* 13(1): 139 (1999): MEL 672627! [labelled 'Nov. Holland austro-occid.' in Sonder's script]; *isolectotypes*: FI 006828!, LD 1731603!, ?M 0097290 image!, MEL 672626, MEL 672628 [?all material not in clear packet], ?S-G-5879 image!). *Paralectotypes* [*syntypes*]: 'arenosis subumbrosis prope oppidulum Perth' [Western Australia], 16 June 1839, *L. Preiss* 2299 (BR 0000005422272 image!, FI 012792!, G 00358849!, G 00358850!, G 00358851!, GOET 011209 image!, L 0001776 image!, LD 1731667!, M 0175779 image!, M 0175780 image!, MEL 672625, MEL 672628 [material in clear packet], MEL 672629, MO-797521 image! [as 14 Oct. 1840], P 00712422!, W [4 sheets]!); King George's Sound [Western Australia, 1834], *Hügel s.n.* (W [2 sheets]!); Swan River [Western Australia, 1831], *Capt. Mangles (n.v.)*; 'Australasia', *s. dat.*, *L. Preiss s.n.* (HBG 510791 image! [presumably type material but cannot be assigned to either of the collections cited above]).

*Notes*. Lowrie *et al.* (1999) selected BM 001041257 (A.H. Burbidge *in sched.*) as the lectotype of *S. repens*; however, this sheet is the Dryander duplicate and may not have been used by Brown for his *Prodromus* descriptions (D.J. Mabberley pers. comm.). Nonetheless, this lectotypification must stand. The Bennett number, which is curiously cited as 2637 in Lowrie *et al.* (1999), is amended to 2606. While M 0097290 and S-G-5879 are unnumbered Preiss collections, they are interpreted as possible duplicates of the lectotype since they are from Sonder's Herbarium and are labelled by him in a near identical fashion to the lectotype.

**Stylidium rotundifolium** R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810). *Candollea rotundifolia* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(T.) v. v.' *Type specimens*: East Coast, Port 1 [Curtis Island or Facing Island, Port Curtis District, Queensland], 5–9 August 1802, *R. Brown s.n.* [Bennett No. 2600] (*holotype*: BM 000563898!).

*Notes*. Bean (2000: 631) selected BM 000563898 as the lectotype of *S. rotundifolium*; however, there is no duplicate material and consequently this sheet is treated herein as the holotype. Although Banks and Solander made a gathering from Endeavour River (BM 000563905, BM 000563907, NSW 133568), it was not cited by Brown (1810) and is therefore not type material.

**Stylidium scandens** R.Br., *Prodr. Fl. Nov. Holland.* 570 (1810). *Candollea scandens* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(M.) v. v.' *Type specimens*: banks of Oyster Harbour River, King George's Sound [Western Australia], December 1801, *R. Brown* [Bennett No. 2595] (*lectotype fide* J.A. Wege, *Nuytsia* 20: 88 (2010): BM 000812595!; *isolectotypes*: BM 000812586!, CANB 279064!, DBN *n.v.*, E 00279205!, E 00279206!, E 00279207!, K 000060294!, K 000060297!, MEL 2104983!, P 00313126!). *Paralectotypes* [*syntypes*]: banks of the lakes towards Cape How [Lake Powell, Western Australia], 23–24 December 1801, *R. Brown s.n.* (BM 000812594!, K 000355275!),

= *S. nymphaeum* Wege; King George's Sound, December 1801, *R. Brown s.n.* (BM 000812585!, K 000741795!), = *S. nymphaeum* Wege.

*Stylidium scandens* var. [published as *β*] *humile* Sond., in Lehm., *Pl. Preiss.* 1(3): 381 (1845). *Type*: 'In subarenosis hieme inundatis districtus Hay' [between Balgarup and Lake Matilda, Western Australia], 8 November 1840, *L. Preiss* 2296 (*lectotype fide* J.A. Wege, *Nytsia* 20: 88 (2010): MEL 293424!; *isoelectotypes*: FI 113180!, G 00358861!, G 00358862!, L 0001777 image!, LD 1000802B!, M 0097291 image!, MEL 293423!, MEL 293425!, MEL 293426!, W! [2 sheets]).

***Stylidium spathulatum*** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea spathulata* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: King George Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2585] (*lectotype fide* J.A. Wege, *Nytsia* 16(1): 234 (2006): BM 000797693!; *isoelectotypes*: BM 000797692!, E!, K 000060697!).

*Stylidium lehmannianum* Sond., *Delectus Seminum quae in Horto Hamburgensis Botanico*: 7 (1844); *S. spathulatum* var. *lehmannianum* (Sond.) Mildbr., in Engl. *Pflanzenr.* IV. 278 (Heft 35): 58 (1908). *Type*: not cited [given by Sond. in Lehm., *Pl. Preiss.* 1: 375 (1845) as 'In solo limoso inter frutices ad latus meridionali-occidentale montis Clarence, Plantagenet [Western Australia], d. 7 Dec. 1840. Herb. Preiss. No. 2261'] (*lectotype fide* J.A. Wege, *Nytsia* 16(1): 234 (2006): MEL 2069495!; *isoelectotypes*: BR 0000005422296 image!, FI 006929!, FI 012790!, G 00358870!, G 00358871!, G 00358872!, GOET 011210 image!, LD 1730707!, MEL 2069496!, MEL 2069497!, MEL 2069498!, MO-797520 image!, P 00712429!, W! [4 sheets]).

*Stylidium lehmannianum* var. [published as *β*] *gracile* Sond., in Lehm., *Pl. Preiss.* 1(3): 376 (1845). *Type*: In limoso-glareosis sterilibus districtus Hay [Western Australia], 8 November 1840, *L. Preiss* 2260 (*lectotype fide* J.A. Wege, *Nytsia* 16(1): 234 (2006): MEL 2069494B!; *isoelectotype*: LD 1753620!). *Paralectotype* [*syntype*]: In rupestribus ad Princess Royal Harbour, 11 October 1840, *L. Preiss s.n.* (MEL 2069494A!).

*Stylidium bellidifolium* Sond., in Lehm., *Pl. Preiss.* 1(3): 376 (1845). *Type*: 'In arenosis ad litus Point Possession', 16 October 1840, *L. Preiss* 2259 (*lectotype fide* J.A. Wege, *Nytsia* 16(1): 234 (2006): MEL 2296913!; *isoelectotype*: G 00358868!, G 00358869!, LD 1753556!, MEL 2296914!, P00712430!, W!).

*Stylidium spathulatum* f. *luxuriens* Wawra, *Itinera principum S. Coburgi* 1: 130 (1883). *Type*: 'Australien, King George's sound' [1872], *H.R. Wawra von Fernsee* Coll. I 909 (*holotype*: W!).

*Stylidium spathulatum* var. *obovatum* Ostenf., *Biol. Meddel. Kongel. Dansk Vidensk. Selsk.* III, 2: 126 (1921). *Type*: Wilgarup, south of Bridgetown, 1 October 1914, *C.H. Ostenfeld* 1071 (*holotype*: K 000060707!).

***Stylidium spinulosum*** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea spinulosa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 85 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: King George's Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2581] (*lectotype*, here designated: BM 000812597!; *isoelectotypes*: BM 000812583!, CANB 279065!, E 00279192!, E 00279193!, E 00279194!, K 000060335!, K 000060337!, MEL 2259809 *n.v.*).

*Notes.* I have mistakenly and inexplicably annotated P00712431 (collected by Ferdinand von Mueller) as type material.

**Stylidium tenerum** Spreng., *Syst. Veg.* (ed. 16) 3: 749 (1826). *Stylidium tenellum* R.Br., *Prodr. Fl. Nov. Holland.* 571 (1810), *nom. illeg., non* Sw. in Willd., *Sp. Pl.* 4(1): 146 (1805). *Type citation*: '(T.) v. v.' *Type specimen*: East Coast Shoal water Bay [Queensland], 6 August 1802, *R. Brown s.n.* [Bennett No. 2599] (*lectotype*, here designated: BM 000563897!; *isolectotypes*: BM 000563908!, E 00279223!, K 000060568!, K 000060570!, MEL 1061494!).

*Notes.* Bean (2000: 601) mistakenly noted that Brown's original description of this species was based on two specimens, one collected by Banks and Solander (who did not collect this species) and the other by Brown. He appears to regard the Brown material at BM, which comprises a specimen from Brown's herbarium (BM 000563897) and the Dryander duplicate (BM 000563908), as a single specimen, annotating both sheets as the lectotype; however, these two specimens should be considered duplicates.

**Stylidium violaceum** R.Br., *Prodr. Fl. Nov. Holland.* 569 (1810). *Candollea violacea* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: '(M.) v. v.' *Type specimen*: Princess Royal Harbour, King George's Sound [Western Australia], December 1801, *R. Brown s.n.* [Bennett No. 2590] (*lectotype*, here designated: BM 000797485!; *isolectotypes*: BM 000797486!, CANB 279066!).

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## ***Hibbertia striata*, a new combination for a long-overlooked Western Australian species, and inclusion of *H. pachyrrhiza* in *H. huegelii***

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### **Abstract**

Thiele, K.R. *Hibbertia striata*, a new combination for a long-overlooked Western Australian species, and inclusion of *H. pachyrrhiza* in *H. huegelii*. *Nuytsia* 28: 247–253 (2017). The common and widespread species *Hibbertia huegelii* (Endl.) F.Muell. comprises two distinct taxa, one of which matches the type of *Candollea striata* Steud., which is here recombined as *Hibbertia striata* (Steud.) K.R.Thiele. *Hibbertia pachyrrhiza* Steud. is reduced to a synonym of *H. huegelii* s. str. Descriptions and distribution maps are provided for both accepted species.

### **Introduction**

Field and herbarium observations aimed at resolving species boundaries between *Hibbertia huegelii* (Endl.) F.Muell., *H. pachyrrhiza* Steud. and related species have shown that two clearly distinct species are subsumed under the concept of *H. huegelii* as currently applied. One is characterised by leaves with acuminate apices and a distinct, narrow sulcus along the adaxial midline, and large flowers with consistently six stamens per bundle, the other by leaves with a more or less obtuse apex and lacking a distinct adaxial sulcus, and smaller flowers with usually four or five stamens per bundle. The two taxa match the types of *Candollea striata* Steud. and *C. huegelii* Endl. (= *H. huegelii* s. str.) respectively. They are both common, reasonably widespread and widely sympatric, and occur in intermixed stands at several locations in the Darling Range east of Perth where they are always distinct with no indication of intermediates. All specimens held at PERTH (as *H. huegelii* s. lat.) can be unambiguously assigned to one or other taxon.

*Candollea striata* was reduced by Bentham (1863) to a synonym of *C. huegelii*. When Mueller (1880) recombined all species of *Candollea* Labill. into *Hibbertia* Andrews, he followed Bentham's opinion regarding these species, and hence *C. striata* has no combination in *Hibbertia*. The *Australian Plant Census* (Council of Heads of Australasian Herbaria 2006–) currently lists *C. striata* as a name of uncertain application. Note that *Candollea striata* (Lindl.) F.Muell. (= *Sylidium striatum* Lindl.) is a later, invalid homonym.

*Hibbertia pachyrrhiza* was described at the same time as *C. striata*. Bentham (1863) combined *H. pachyrrhiza* into *Candollea*, remarking that it was '[n]early allied to *C. huegelii* [in his sense, i.e. including *C. striata*], and possibly a variety only', and describing it as having 'stems erect,

apparently arising from a thick rhizome, and more or less silky-hairy, as well as the leaves', with smaller flowers and fewer stamens per bundle. Wheeler (2004) followed Bentham in describing the leaves of *H. pachyrrhiza* as silky-hairy *cf.* glabrous in *H. huegelii*, and the flowers as being smaller (sepals 6–12 mm long *cf.* 10–17 mm respectively). In *Flora of the Perth Region* (Wheeler 1987), *H. pachyrrhiza* was described as having obtuse leaves *cf.* acute in *H. huegelii*, and Bentham's comments regarding the close similarity between the two species were noted, concluding that 'further studies are needed to clarify their relationships'. It is likely that *H. pachyrrhiza* was being compared with *C. striata* rather than *H. huegelii* s. str.

Field observations strongly indicate that *H. pachyrrhiza* comprises somewhat hairy individuals that in all other respects match *H. huegelii* s. str. Most specimens at PERTH comprise strong, upright new growth from the rootstock following fire, for this reason usually collected with part of the rootstock as described by Bentham (1863). Older plants form low, branching shrubs, specimens from which usually comprise a branch only. Specimens of *H. huegelii* s. str. (i.e. with *C. striata* removed) always have more or less hairy leaves, with the length and extent of indumentum variable. The obtuse leaves noted by Wheeler (1987) match those of *H. huegelii* s. str. The flower sizes of the PERTH specimens of *H. huegelii* s. str. and *H. pachyrrhiza* are also similar, again in contradistinction to *C. striata*, which usually has larger flowers. With specimens of *C. striata* removed, the distributions of *H. huegelii* s. str. and *H. pachyrrhiza* are almost entirely co-extensive. Finally, field visits to areas where *H. pachyrrhiza* has been collected yield abundant plants of *H. huegelii* s. str. exhibiting a continuous range in leaf indumentum.

This paper resolves the confusion surrounding these taxa by recombining *Candollea striata* into *Hibbertia* as *H. striata* (Steud.) K.R.Thiele, reducing *H. pachyrrhiza* to a synonym of *H. huegelii*, and recircumscribing *H. huegelii* to exclude specimens now referred to *H. striata*. Descriptions and distribution maps are provided for both accepted taxa.

## Taxonomy

***Hibbertia striata*** (Steud.) K.R.Thiele, *comb. nov.*

*Candollea striata* Steud., in J.G.C. Lehmann, *Pl. Preiss.* 1(2): 275 (1845), *non C. striata* (Lindl.) F.Muell., *Syst. Census Austral. Pl.* 86 (1882), *nom. illeg.*, *nom. superfl.* (= *Stylidium striatum* Lindl.). *Type*: 'In arenosis prope oppidulum Perth, 6 Jun. 1839. Herb. Preiss. No. 2148.' (*syn*: BR 13462604 image!, FI 10053 image!, HBG 507147 image!, LD 1811953 image!, M 212901 image!, MEL 666854!, 666855!, 666856!, 666857!, 666858!, 666859!, MO 279481 image!, P 2142792 image!, 2142793 image!, 2142794 image!, S 08-20926 image!).

*Hibbertia huegelii* (Endl.) F.Muell. var. *subvillosa* Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přir.* 2: 73 (1923). *Type*: 'Northam, GREGORY X. 1900.' (*syn*: K 700375 image!, PERTH 03074927).

Spreading *shrubs* (15–)20–50(–75) cm high, resprouting from the rootstock after fire; branchlets glabrous to moderately pubescent with crisped, sometimes ±arachnoid, appressed, pale grey, simple hairs. *Leaves* widely spreading, alternate, linear to narrowly linear-obovate, (25–)30–60(–90) mm long, 1–2(–8) mm wide, the margins usually strongly revolute and completely obscuring the undersurface except the broad midrib (rarely loosely or narrowly recurved, the undersurface then largely visible); base broadly flattened and with a wide, shallow insertion on the stem, not forming a distinct petiole; adaxial surface smooth, flat to rounded with a distinct, narrow, deep groove or sulcus along the

midline, usually glabrous except near the basal margins, rarely sparsely to moderately appressed-pubescent to pilose with pale grey, simple hairs, the indumentum more dense towards the base especially along the margins where it sometimes forms a distinct fringe; abaxial surface glabrous except for the midrib which may have an indumentum as for the adaxial surface but usually sparser; apex acuminate with midrib extended as a thickened but non-pungent, straight to somewhat recurved point. *Flowers* sessile, single, terminal or terminating short shoots in upper leaf axils; primary bract narrowly ovate-triangular, 6–15 mm long, herbaceous to somewhat scarious, with indumentum as for the leaves; secondary bracts usually several (rarely absent), grading to the leaves. *Sepals* 5, ovate-acuminate (rarely ovate-acute), (10–)12–18(–24) mm long, sparsely to moderately (rarely densely) appressed-pubescent to spreading-sericeous with white, simple hairs; midribs not prominent; inner and outer sepals similar in size, apex shape and indumentum. *Petals* 5, yellow, obovate, 12–15 mm long, usually emarginate. *Stamens* (28–)30(–35), in 5 distinct bundles alternating with the carpels, each bundle with (5)6(–8) stamens, the inner one often  $\pm$ free, the remainder distinctly fused by their filaments; filaments (including fused portion) 1.2–2 mm long; anthers rectangular, 1.8–2.5 mm long, dehiscent by introrse, longitudinal slits. *Staminodes* absent. *Carpels* 5; ovaries compressed-ovoid, glabrous; styles spreading widely and excentrically from the carpel apex, 2.5–5 mm long. *Ovule* 1 per carpel. *Fruiting carpels* and seeds not seen.

*Diagnostic features.* Can be uniquely diagnosed from all other species of *Hibbertia* in Western Australia that have stamens in fused bundles around the carpels and narrow leaves with margins closely revolute to a distinct midrib, by its leaves having a distinct, narrow sulcus along the midline above, and a hard, acute-acuminate apex.

*Selected specimens examined.* WESTERN AUSTRALIA: W of Three Springs, 24 Sep. 1940, *W.E. Blackall* 4874 (PERTH); Ellis Brook Valley Reserve, 19 Sep. 1999, *H. Bowler* 619 (PERTH); Water Reserve No. 16418 adjacent to the Wongan Hills townsite, 23 Sep. 1991, *A.M. Coates* 2950 (PERTH); Maida Vale, at corner of Kalamunda Road and Midland Road, 3 Oct. 1996, *M.G. Corrick & B.A. Fuhrer* MGC 11253 (PERTH); S Eneabba Road, 15 July 1980, *R.J. Cranfield* 1477 (PERTH); 5.7 km W of Brand Highway along Shaw Road, Eneabba, 1 July 1992, *R.J. Cranfield & P.J. Spencer* 8234 (PERTH); Roberts Road, off Cockburn Road, 7 Nov. 1975, *H. Demarz* D 5831 (PERTH); 25 km c. E of York, 31 Aug. 1988, *B. Dixon* D 28/88 (PERTH); 7 km S of Eneabba, 10 July 1977, *E.A. Griffin* 887 (PERTH); along main road from Gingin to Dongara at crossing with Boothendara Creek, 15 Sep. 1971, *R.D. Hoogland* 11964 (PERTH); along Great Northern Highway, a few miles N of Pierce, at mile peg 32 from Perth, 26 Sep. 1971, *R.D. Hoogland* 12015 (PERTH); both sides of Perry Road, 0.15–0.55 km S of junction with Bell Road, Shire of Dalwallinu, 15 Sep. 1999, *J.W. Horn* 2475 (PERTH); Mission Road, 18 km NNW of Kojonup, 2 Nov. 1998, *C.M. Lewis* 387 (PERTH); SW corner of camping reserve, Bunny Road W side at 3.6 km N of Skipper Road, 10 Oct. 2002, *S. Patrick* 4502 (PERTH); near Yanchep National Park, 22 Sep. 1962, *M.E. Phillips* WA/62 912 (PERTH); 13 km NE of Yandanooka, on private land, Aug. 1998, *R. Soullier* 610 (PERTH); site ML35, N of Gngangara Road, S side of Lot 47 Lexia Avenue, locality of Ellenbrook, 1 Sep. 1999, *M. Trudgen & S. Firth* MET 20372 (PERTH); Mogumber West Road, 27.5 km by road E of Brand Highway, 3 Sep. 1984, *J.R. Wheeler* 2325 (PERTH); c. 20 km E of Piawaning, 16 Sep. 1988, *J.R. Wheeler* 2532 (PERTH).

*Phenology.* Flowers from July to November with a distinct peak in September.

*Distribution and habitat.* Widespread from the vicinity of Morawa and Mingenew south to Mundijong and east to Dalwallinu, Wongan Hills, York and Brookton, with outlying populations near Yarloop, Bunbury and Kojonup (Figure 1). *Hibbertia striata* has a substantially wider distribution than *H. huegelii*, including on the Swan Coastal Plain where *H. huegelii* is largely absent. Occurs in a wide variety of

habitats including jarrah, marri and wandoo forests and woodlands, *Banksia* woodlands, kwongan and shrublands, on sandy and loamy soils over laterite and (rarely) coastal limestones.

*Conservation status.* Common and widespread and not considered to be under threat.

*Notes.* *Hibbertia striata* differs most noticeably from *H. huegelii* in its distinctly acuminate leaves with a distinct, narrow sulcus along the midrib above, and in its larger flowers. It consistently has more stamens per bundle (6 *cf.* usually 4 or 5). The styles in *H. striata* spread widely and more or less horizontally from the apex of the carpels so that the stigmas are borne outside and below the anthers, whereas in *H. huegelii* the styles are more erect and the stigmas are borne above the anthers. When co-occurring, *H. striata* and *H. huegelii* may be readily distinguished at a distance even when not in flower by the taller habit of the former with fewer, less-branched stems and finer, paler green leaves contrasting with the lower, many-stemmed habit and shorter, broader, darker leaves of the latter.

*Hibbertia striata* flowers in late winter and early spring, with a distinct peak in September. By contrast, *H. huegelii* may flower at almost any time of the year. At a mixed population in Wandoo National Park (K.R. Thiele 5386, 5387), *H. huegelii* plants did not flower at all during the spring flowering season of *H. striata*; it is possible that *H. huegelii* requires fire to flower freely, while *H. striata* does not.

The androecium of *H. striata* is remarkably consistent. Each of the five staminal bundles usually comprises six (rarely five, or to eight) stamens. An innermost stamen is erect and has a filament that diverges from the bundle low down, sometimes at the very base. The remaining five stamens are in two groups and have very short free filaments distal to the fused portion. The outermost pair spread widely, while a middle group of three forms a linear series between the innermost stamen and the outermost pair, at right angles to the radius of the flower. The anthers of all but the innermost stamen are somewhat kinked at their insertion on the filaments. Flowers with fewer or more stamens than the usual six have the same basic pattern, but with missing or supernumerary stamens in the middle or outer positions.

The type of *H. huegelii* var. *subvillosa* has the typical dorsal sulcus and acute-acuminate leaf apex of *H. striata*. It has a denser indumentum on all its parts. Specimens with a similar indumentum are common on the inland side of the range of *H. striata*, as at Northam where the type of this name was collected.

Many specimens collected from near Eneabba and Warradarge (e.g. PERTH 02387131) have unusually broad leaves with scarcely revolute margins. Similarly broad- and flat-leaved plants of *H. hypericoides* (DC.) Benth. occur in the same area (Thiele & Cockerton 2015). These specimens are typical of *H. striata* in all other respects; further research is needed to determine if they could be recognised as a distinct taxon.

***Hibbertia huegelii*** (Endl.) F.Muell., *Fragm.* (Mueller) 11(92): 95 (1880). *Candollea huegelii* Endl., in S.F.L. Endlicher, E. Fenzl, G. Benth. & H.W. Schott, *Enum. Pl.* [Endlicher] 2 (1837); *Hibbertia huegelii* (Endl.) F.Muell. var. *subglabra* Domin, *Věstn. Král. České Společn. Nauk. Tř. Mat.-Přir.* 2: 73 (1923), *nom. illeg.* Type: 'Swan-River. (Hügel.)' (*holo*: W 46813 image!).

*Hibbertia pachyrrhiza* Steud., in J.G.C. Lehmann, *Pl. Preiss.* 1(2): 269 (1845); *Candollea pachyrrhiza* (Steud.) Benth., *Fl. Austral.* 1: 44 (1863). Type: 'In arenosis montium Darlings-range, ditionis Perth, 20. Mart. 1839. Herb. Preiss. 2149.' (*syn*: HBG 507140 image!, LD 1359197 image!, MEL 666689!, MO 279474 image!, P 682361 image!, S 08-20157 image!).

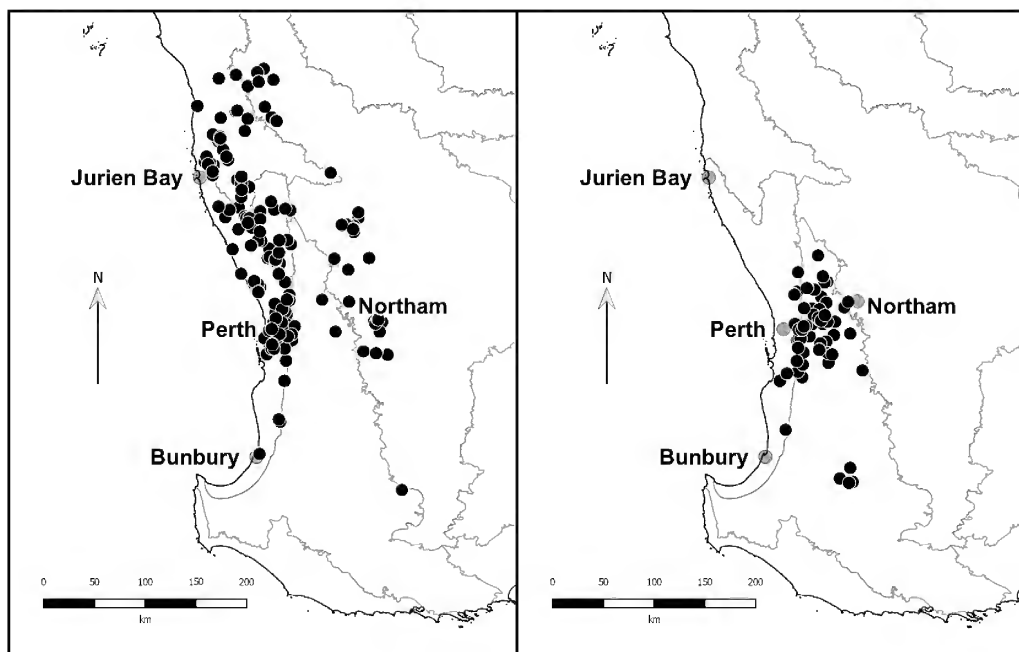


Figure 1. Distribution of *Hibbertia striata* (left) and *H. huegelii* (right) in south-western Australia.

*Hibbertia basitricha* Steud., in J.G.C. Lehmann, *Pl. Preiss.* 1(2): 268 (1845). *Type*: ‘In confragrosis ad radices jugi montium Darling’s-range, ditionis Perth, 4. Dec. 1839. Herb. Preiss. No. 2165.’ (*syn*: LD 1242793 image!, MEL 666690!, MO 279563 image!, P 2428366 image!, S 08-20001 image!).

*Candollea cygnorum* Steud., in J.G.C. Lehmann, *Pl. Preiss.* 1(2): 275 (1845). *Type*: ‘In arenosi prope cataractam ad caput fluvii Cygnorum, 26. Jul. 1839. Herb. Preiss. No. 2174.’ (*syn*: LD 1240802 image!, P 682355 image!).

Spreading *shrubs* 20–30(–50) cm high, resprouting from the rootstock after fire; branchlets sparsely to densely villous with sinuous to crisped, loosely appressed to  $\pm$ spreading, white to pale grey simple hairs. *Leaves* erect to spreading, alternate, linear to very narrowly linear-obovate, (20–)30–40(–60) mm long, (0.8–)1–1.5(–2) mm wide, the margins strongly revolute and usually completely obscuring the undersurface except the broad midrib; base broadly flattened and with a wide, shallow insertion on the stem, not forming a distinct petiole; adaxial surface smooth, evenly rounded or sometimes with a broad, shallow, indistinct groove along the midline, sparsely (rarely moderately) pilose with simple hairs as for the stems (sometimes  $\pm$ glabrescent), the indumentum usually more dense towards the base especially along the margins where it sometimes forms a distinct fringe; abaxial surface glabrous or with indumentum as for the adaxial surface but usually sparser; apex obtuse to bluntly acute, straight. *Flowers* sessile (rarely with a pedicel to 5 mm long), single, terminal or terminating short shoots in upper leaf axils; primary bract narrowly ovate-acuminate, (4–)7–10 mm long, herbaceous to somewhat scarious, in pedicellate flowers inserted at the base of the pedicel, with indumentum as for the leaves. *Sepals* 5, ovate-acuminate (rarely ovate-acute), (6–)8–10(–13) mm long, glabrous to moderately (rarely densely) appressed-sericeous with short, white,  $\pm$ appressed simple hairs; midribs not prominent; inner and outer sepals similar in size, apex shape and indumentum. *Petals* 5, yellow, obovate, 8–11 mm long, usually emarginate. *Stamens* 15–25(–34), in 5 distinct bundles alternating with the carpels, each

bundle with (3)4 or 5(–9) stamens, the inner one often  $\pm$ free, the remainder distinctly fused by their filaments; filaments (including fused portion) 1.5–2 mm long; anthers rectangular, 2–2.5 mm long, dehiscent by introrse, longitudinal slits. *Staminodes* absent. *Carpels* (3)4 or 5; ovaries compressed-ovoid, glabrous; styles excentrically curved-erect from the carpel apex, 2.5–3.5 mm long. *Ovule* 1 per carpel. *Fruiting carpels* and seeds not seen.

*Diagnostic features.* Can be uniquely diagnosed from all other species of *Hibbertia* in Western Australia that have stamens in fused bundles around the carpels and narrow leaves with margins closely revolute to a distinct midrib, by the  $\pm$ obtuse leaves lacking a distinct, narrow sulcus along the midline above, and the white to pale grey indumentum on sepals and leaves with hairs more dense towards the base and forming a  $\pm$ distinct fringe along the margins.

*Selected specimens examined.* WESTERN AUSTRALIA: N of Cooks Road near farms, 23 km ESE of Bindoon, 20 Nov. 1996, M.G. Allen 1291 (PERTH); Guildford, June 1901, C. Andrews s.n. (PERTH); 24 mile peg Albany Highway [c. 2 km S of Road Train Transfer Station on Albany Highway], 6 Nov. 1961, T.E.H. Aplin 1205 (PERTH); side of West Talbot Road, 6 Mar. 1997, R. Davis 2765 (PERTH); South Road, Mundaring, 16 Nov. 1967, J. Havel 611 (PERTH); bushland at corner of Keating and Beach Roads, Chittering, 6 Dec. 1998, M. Hislop 1266 (PERTH); along South Western Highway E of Mundijong, 13 Nov. 1974, R.D. Hoogland & G.L. Stebbins 12500 (PERTH); road to Mount Dale, near intersection with Bibbulmun Track, 23 Feb. 2000, K. Macey 63 (PERTH); Kalamunda National Park, Powerline Track between Fern Road and Bibbulmun Track, 1 Nov. 2000, K. Macey 260 (PERTH); E of Watsonia Road, Gooseberry Hill, 20 Sep. 1996, A. Markey 467 (PERTH); South Western Highway, 1.1 km N of Jarrahdale turnoff, 7 Nov. 1985, A.N. Rodd & G. Fensom ANR 4813 (PERTH); Helena Valley, 16 Oct. 1977, J. Seabrook 357 (PERTH); Norwood Reserve, Maida Vale, 3.8 km WNW of Kalamunda, 28 Oct. 2003, G. Smith 110 (PERTH); Norwood Reserve, 3.8 km WNW of Kalamunda, 16 Nov. 2009, G. Smith 230 (PERTH); Darling Range, near Walyunga National Park, c. 2 km along Copley Dale Road from Clenton Road, 28 Aug. 1984, J.R. Wheeler 2312 (PERTH).

*Phenology.* Flowers sparingly throughout the year, with a peak in spring (August–October). Field observations suggest that it may be a shy flowerer in the absence of recent fire.

*Distribution and habitat.* Occurs on the Darling Range from east of Wannamal to west of Mt Solus, with outlying populations north of Trigwell Bridge (Figure 1). Apparently absent from the Swan Coastal Plain with the exception of two records (B.J. Keighery 2412; R. Fairman 21/93) east and north-east of Mandurah. Note that this is a substantially smaller range than that of *H. striata*, and hence a considerable reduction in range from that previously considered for the species *sensu lato*. Recorded from marri, jarrah and wandoo woodlands, mostly on clay or loam soils.

*Conservation status.* Common and widespread and not considered to be under threat.

*Notes.* The type of Steudel's *H. basitricha* has leaves that are slightly more hairy towards the base than on the type of his *H. pachyrrhiza*, but is otherwise identical. Steudel's *C. cygnorum* has been regarded as of uncertain application since Bentham (1863), who did not see material, and cast doubt on its status including (based on Steudel's description) whether it belongs in Dilleniaceae. Two type sheets are known, each with a short leafy sprig with a single terminal flower. The flower on LD 1240802 is sessile, while the one on P 682355 appears to be shortly pedicellate. In both cases, the specimens are consistent with *H. huegelii*. The P sheet of *H. pachyrrhiza* (P 2142787) bears a label in Steudel's hand with the collecting number 2144, and the same collecting details (locality, date) as on the other

syntypes; LD 1359197 bears a Steudel slip with the same collecting number. This is likely to be a transcription error (from 2149) on Steudel's part since *Preiss* 2144 is a specimen of *H. argentea* Steud.

A striking feature of Steudel's *Plantae Preissianae* treatment of Dilleniaceae is that he assigned his new species to either *Candollea* (e.g. *C. striata*, *C. cygnorum*) or *Hibbertia* (e.g. *H. pachyrrhiza*, *H. basitricha*) despite the fact that all have stamens united into bundles, the diagnostic feature of *Candollea*. None of Steudel's protologues describe the androecium or gynoecium, and he appears to have largely overlooked these critical features.

*Hibbertia huegelii* may be reliably discriminated from *H. striata* by the relatively obtuse leaf apices and absence of a distinct, narrow sulcus along the midline of the adaxial leaf surface; at most, some leaves on some specimens may have a broad, shallow, indistinct groove along the midline, but this will be absent on many leaves.

*Hibbertia ferruginea* J.R. Wheeler is somewhat similar to *H. huegelii*, but has generally more acute leaves, and a distinctive ferrugineous rather than pale grey to white indumentum on the sepals. *Hibbertia huegelii* may be more closely related to *H. desmophylla* (Benth.) F.Muell. (which differs in having shorter, broader and more or less distinctly fascicled leaves) than to *H. striata*, but a detailed phylogenetic analysis is required before this can be determined.

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**Nomenclatural changes in *Chenopodium* (incl. *Rhagodia*)  
(Chenopodiaceae), with considerations on relationships of some  
Australian taxa and their possible Eurasian relatives**

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**Abstract**

Mosyakin, S.L. & Iamónico, D. Nomenclatural changes in *Chenopodium* (incl. *Rhagodia*) (Chenopodiaceae), with considerations on relationships of some Australian taxa and their possible Eurasian relatives. *Nuytsia* 28: 255–271 (2017). Following recent molecular phylogenetic results, species earlier placed in *Rhagodia* R.Br. were transferred to *Chenopodium* L. (Chenopodiaceae). However, three new species-level combinations proposed were later homonyms and thus illegitimate under ICN Art. 53.1. The new name *C. wilsonii* S.Fuentes, Borsch & Uotila [= *C. crassifolium* (R.Br.) S.Fuentes & Borsch, *comb. illeg.*] has been already proposed for one of these species. We propose here two new replacement names, *C. robertianum* Iamónico & Mosyakin, *nom. nov.* [≡ *R. hastata* R.Br. ≡ *C. hastatum* (R.Br.) S.Fuentes & Borsch, *comb. illeg.*] and *C. benthamii* Iamónico & Mosyakin, *nom. nov.* [≡ *R. crassifolia* R.Br. var. *latifolia* Benth. ≡ *C. latifolium* (Benth.) S.Fuentes & Borsch, *comb. illeg.*]. One new combination, *C. benthamii* subsp. *rectum* (Paul G.Wilson) Iamónico & Mosyakin, *comb. nov.* [≡ *R. latifolia* (Benth.) Paul G.Wilson subsp. *recta* Paul G.Wilson] is also validated. Indications of ‘holotypes’ of *R. hastata* by Scott and *R. crassifolia* var. *latifolia* by Wilson are corrected to lectotypes according to ICN Art. 9.9. Possible relationships and biogeographical links of Australian species earlier placed in *Rhagodia*, *Einadia* Raf., and Australian endemic groups of *Chenopodium* (sections *Auricoma* Aellen, *Desertorum* Paul G.Wilson, *Rhagodioides* Benth. etc.) with Eurasian taxa of *Chenopodium* (in particular, *C.* sect. *Acuminata* Ignatov, *C. frutescens* C.A.Mey., and newly recognised *C.* sect. *Vulvaria* (Standl.) Iamónico & Mosyakin, *comb. nov.*) are also discussed. Earlier predictions of these possible relationships are emphasised and new predictions are made, which should be tested by molecular phylogenetic and other methods.

**Introduction**

The family Chenopodiaceae (included in Amaranthaceae *s. lat.* according to APG 1999, APG II 2003, APG III 2009, APG IV 2016, but accepted as a distinct family in Hernández-Ledesma *et al.* 2015 and by nearly all experts in the group), as traditionally circumscribed, comprises 100–110 genera and approximately 1,600–1,700 species occurring in arid to semiarid, saline and disturbed habitats of temperate and subtropical regions, with a few representatives in the tropics (see e.g. Ulbrich 1934; Aellen 1960–1961; Kühn 1993; Hernández-Ledesma *et al.* 2015). The classification of this family and

the taxonomy of many groups within Chenopodiaceae were considerably changed, especially recently, following the progress of molecular phylogenetic studies (see Kadereit *et al.* 2003; Shepherd *et al.* 2004; Kadereit *et al.* 2005; Shepherd *et al.* 2005; Akhani *et al.* 2007; Cabrera *et al.* 2009; Kadereit *et al.* 2010; Cabrera *et al.* 2011; Kadereit & Freitag 2011; Fuentes-Bazan *et al.* 2012a; Fuentes-Bazan *et al.* 2012b; Kadereit *et al.* 2014; Walsh *et al.* 2015; Schüssler *et al.* 2016; Piirainen *et al.* 2017 etc.).

Among the critical groups of Chenopodiaceae, the phylogeny of *Chenopodium* L. s. lat. was only recently studied in detail by Fuentes-Bazan *et al.* (2012a, 2012b and references therein) who proposed a new classification scheme supporting some earlier phylogenetic results (e.g. Kadereit *et al.* 2003; Kadereit *et al.* 2005; Kadereit *et al.* 2010). Phylogenetically isolated positions of some segregate genera were confirmed in modified circumscriptions, e.g. *Blitum* L. (incl. *Monolepis* Schrad., *Scleroblitum* Ulbr.; see Fuentes-Bazan *et al.* 2012b, and compare to Scott 1978c) and *Dysphania* R.Br. (see Mosyakin & Clemants 2002; Clemants & Mosyakin 2003; Mosyakin & Clemants 2008; Shepherd & Wilson 2008, 2009; Fuentes-Bazan *et al.* 2012b etc.). Also, some long-forgotten genera were resurrected, such as *Lipandra* Moq., *Oxybasis* Kar. & Kir. and *Teloxys* Moq., and the new genus *Chenopodiastrum* S.Fuentes, Uotila & Borsch was proposed (Fuentes-Bazan *et al.* 2012b). The generic classification outlined in Fuentes-Bazan *et al.* (2012b) is now becoming almost universally accepted in many newer publications (e.g. Iamonico 2012; Mosyakin 2013; Uotila 2013; Sukhorukov *et al.* 2013; Iamonico 2014; Sukhorukov 2014; Sukhorukov & Kushunina 2014; Hernández-Ledesma *et al.* 2015).

On the other hand, some nomenclatural issues in *Chenopodium* still remain unresolved. Because of conflicting typifications of the genus [*C. album* L. vs *C. rubrum* L., now *Oxybasis rubra* (L.) S.Fuentes, Uotila & Borsch], a formal proposal to conserve this generic name with *C. album* as a conserved type has been made by Mosyakin (2015; see additional comments in Mosyakin *et al.* 2017). However, if the proposal by McNeill *et al.* (2016b) on selection of types of generic names using a largely mechanical method is accepted, for which there are very high chances (see also McNeill *et al.* 2016a; Turland & Wiersma 2017), the typification of *Chenopodium* with *C. rubrum* (Britton & Brown 1913; Standley 1916) will be superseded and *C. album* will be the non-supersedable type of the genus, regardless of any decision on the *Chenopodium* conservation proposal (Mosyakin 2015).

### ***Rhagodia*, *Einadia* and *Chenopodium*: an overview of possible relationships**

#### **Historical studies**

The Australian genera *Rhagodia* R.Br. and *Einadia* Raf. (sometimes merged into a single genus under the priority name *Rhagodia*) were segregated by Scott (1978a), together with South American *Holmbergia* Hicken, in a separate subtribe Rhagodiinae A.J.Scott. However, Kadereit *et al.* (2010) demonstrated that *Holmbergia* should be placed in the tribe Atripliceae Duby within the *Archiatriples* G.L.Chu clade, where its position remained unresolved. Kadereit *et al.* (2010) commented, however, that '[m]orphologically, *Holmbergia* does not show particular similarities to any of the other genera of the *Archiatriples* clade' and also mentioned that, despite having superficially similar fleshy or coloured fruits, *Holmbergia* and *Rhagodia* are profoundly different in their pericarp anatomy. In fact, 'the 3–5(6)-layered, undifferentiated pericarp of *Holmbergia* is dry, and the reddish appearance of the fruit is caused by the hard, dark red-brown testa' (Kadereit *et al.* 2010: 1672; see also Sukhorukov 2014). Thus, *Holmbergia* is excluded from our further discussion.

The uncertainty of delimitation between *Chenopodium*, *Rhagodia* and *Einadia* was already recognised by botanists of the 19<sup>th</sup> Century. In fact, the similarity between *Chenopodium* and *Rhagodia* was

noted by Brown (1810: 408), who provided the following observation in the protologue of his newly described genus: ‘Obs. *Chenopodio proxima*; Fructu baccato floribusque polygamis diversa’. Bentham commented in reference to *Rhagodia* ‘[t]his genus is exclusively Australian, differing from *Chenopodium* in the succulent pericarp and usually in the more shrubby habit’ (Bentham 1870: 152); however, when discussing *Chenopodium* he stated that ‘[t]he precise limits to be assigned to the genus are as yet very uncertain’ (Bentham 1870: 157). The translation from German of Diels and Pritzel (1905: 179) reads: ‘The genus *Rhagodia*, which is widely represented in Western Australia, is only slightly different from *Chenopodium*. Several species assigned to it are still unknown with their fruits and therefore cannot be classified with certainty’. Aellen (1939, 1960–1961, 1964) included taxa of *Einadia* in *Chenopodium* and placed them in his *C. sect. Polygonoidea* Aellen.

Wilson (1987) in his important but rarely cited article proposed a scheme based on morphological evidence where *Rhagodia* was placed as sister to *C. sect. Desertorum* Paul G. Wilson, *Einadia* was considered to be close to *C. sect. Leprophyllum* Dumort. (now *sect. Chenopodium*, if *C. album* is accepted as the lectotype of the genus), and *C. sect. Rhagodioides* Benth. was placed between these two groups. In his earlier publications Wilson (1983, 1984) also emphasised possible links between the mentioned groups. He considered possible taxonomic solutions and concluded that ‘a nomenclature that reflects a more natural classification of the Australian “mealy” members of the *Chenopodium* complex is required but it is unclear as to whether this is better achieved by raising the various sections to generic rank or whether the circumscription of *Chenopodium* should be expanded to encompass genera such as *Einadia* and *Rhagodia*. This matter is difficult to resolve in isolation since a number of extra-Australian sections and genera are involved’ (Wilson 1987: 80). The close evolutionary links between these Australian genera and corresponding sections of *Chenopodium* were also discussed by Mosyakin (2003a, 2003b, and references therein). Furthermore, uncertain circumscriptions of *Chenopodium*, *Einadia* and *Rhagodia* are also evident from the synonymy of Australian species, where some recognised taxa often have synonymic names and combinations available in all three genera (Wilson 1983, 1984, 1987; Council of Heads of Australasian Herbaria 2005–; IPNI 2012).

### Reliability of morphological characters

Fleshy fruits or infructescences occur in some species belonging to several genera of Chenopodiaceae, e.g. *Chenopodium* (incl. *Rhagodia*), *Blitum*, *Suaeda* Forssk. ex J.F.Gmel., *Anabasis* L., *Enchylaena* R.Br., and some others (Ulbrich 1934; Wilson 1984; Kühn 1993; Mosyakin 2003b; Sukhorukov & Zhang 2013; Sukhorukov 2014); the modified parts becoming fleshy (succulent) at the fruiting stage are mainly perianth segments (tepals) or the pericarp. Thus, the inclusion of fleshy-fruited taxa of *Rhagodia* and *Einadia* in *Chenopodium* should not be seen as a great surprise. As noted by Kadereit *et al.* (2010: 1672): ‘Berry-like fruits evolved several times in Chenopodiaceae in rather isolated positions. This character state does not seem to be phylogenetically informative in the family’. Dinan *et al.* (1998: 572), after studying phytoecdysteroids of selected taxa of Chenopodiaceae, emphasised ‘the close association between *Einadia* and *Rhagodia* with *Chenopodium* subgenus *Chenopodium*, especially sections *Polygonoidea* and *Desertorum*, respectively’. Thus, close links of *Rhagodia* and taxa of *Chenopodium* are confirmed by evidence from carpology (Sukhorukov & Zhang 2013; Sukhorukov 2014) and biochemistry (Dinan *et al.* 1998).

As it has been demonstrated by recent molecular studies (Kadereit *et al.* 2003; Kadereit *et al.* 2010; Kadereit & Freitag 2011; Fuentes-Bazan *et al.* 2012b etc.) and suggested by many earlier authors (e.g., Ulbrich 1934; Wilson 1987; Kühn 1993, among others), in Chenopodiaceae (as well as in many other taxonomically complicated groups of plants) some easily observable and eye-catching characters that were used in pre-molecular taxonomy as diagnostic features for distinguishing genera are often

misleading, and especially for phylogenetic inferences. This is evident in the tribe Camphorosmeae Moq. (including Sclerolaeneae A.J.Scott and Maireaneae A.J.Scott) (see Wilson 1987; Cabrera *et al.* 2009, 2011; Kadereit & Freitag 2011; Kadereit *et al.* 2014; and compare with Scott 1978b), as genera therein were traditionally delimited mainly on the presence and/or shape of appendages on fruiting perianth segments (wings, spines, hooked or winged spines, tubercles etc.) and some other rather evident characters. However, new studies showed that similar appendages can be present in different and phylogenetically distant clades, while morphologically very different appendages may occur in one clade. It is especially true for Australian taxa of Camphorosmeae (earlier sometimes segregated in a separate tribe or even two tribes, see above), in which the limits and circumscriptions of many genera still remain obscure (Cabrera *et al.* 2009, 2011). No satisfactory generic rearrangement in that group has been proposed so far. Evidently, search for alternative and often not so evident diagnostic characters (including anatomical and micromorphological ones) is needed in that and many other groups of Chenopodiaceae to achieve reliable and morphologically supported genus-level classification.

### Phylogenetic studies

Recent molecular phylogenetic studies of *Chenopodium* and its relatives have unfortunately included only a few species of Australian endemic taxa of *Chenopodium*, *Rhagodia* and *Einadia*. While these studies in general confirmed the close links of *Rhagodia* and *Einadia* with *Chenopodium s. str.*, the nature of these links remained largely unresolved. For example, Kadereit *et al.* (2003) included in their analysis *C. auricomum* Lindl., *C. desertorum* (J.Black) J.Black and *R. drummondii* Moq., and reported that these three Australian species appeared ‘in a well-supported subclade (78% bootstrap) sister to the taxa from Eurasia and Juan Fernandez Islands’ (Kadereit *et al.* 2003: 976). The non-Australian species included were Eurasian *C. acuminatum* Willd. and *C. frutescens* C.A.Mey., and Juan Fernándezian *C. sanctae-clarae* Johow, which was hardly a representative sampling for such a widespread and diverse group containing numerous Eurasian, American and African taxa. Despite that, this important pioneering molecular phylogenetic study has already demonstrated (1) the position of a *Rhagodia* in a clade with the two other Australian species and within the larger clade of Chenopodieae I (containing the ‘typical’ taxa of *Chenopodium*), and (2) the fundamental divergence between Chenopodieae I, Chenopodieae II (containing *Blitum*, *Spinacia* L. etc.), and Chenopodieae III (containing *Dysphania* in a narrow sense, ‘glandular’ species of *Chenopodium s. lat.*, etc.). These data for the first time convincingly confirmed the predictions regarding the profound split between ‘mealy’ and ‘glandular’ taxa made by earlier authors (Carolin 1983; Wilson 1983, 1987; Mosyakin & Clemants 2002). For example, Wilson’s (1987) ‘glandular’ taxa (*Dysphania s. str.*, *C. sect. Orthosporum* R.Br. and ‘*C. sect. Ambrina*’) were placed in a clade opposite to another clade of ‘mealy’ taxa having vesicular trichomes (incl. *Scleroblitum*, *Chenopodium*, *Einadia*, *Rhagodia* and *Atriplex* L.). The links between Australian taxa usually placed in *Dysphania* and *C. sect. Orthosporum* were also discussed earlier by Aellen (1930a, 1930b, 1933), who, however, preferred at that time to subsume *Dysphania* under *Chenopodium*.

Kadereit *et al.* (2005) confirmed the findings reported in Kadereit *et al.* (2003) and hypothesised that ‘*Chenopodium* subg. *Chenopodium/Rhagodia* (4.7–2.9 Mya) both arrived [to Australia] during the Pliocene’; at the same time they recognised that ‘[t]he geographic origin of the *Chenopodium* subg. *Chenopodium/Rhagodia* clade, and its mode of entering Australia, are unclear and needs further extended sampling’ (Kadereit *et al.* 2005: 77). In an expanded study Kadereit *et al.* (2010) placed *Rhagodia* (with *R. drummondii* and *R. parabolica* R.Br. sampled) and *Einadia* (with *E. nutans* (R.Br.) A.J.Scott sampled) in a subclade including Australian *C. auricomum*, *C. desertorum* and *C. nitrariaceum* (F.Muell.) Benth. within the Chenopodieae *s. str.* (Chenopodieae I) clade.

Fuentes-Bazan *et al.* (2012a, 2012b) included in their analysis *E. nutans* (*C. nutans* (R.Br.) S.Fuentes & Borsch) and *R. triandra* (G.Forst.) Aellen (*C. triandrum* G.Forst.) and confirmed that *Rhagodia* and *Einadia* are phylogenetically rooted in *Chenopodium s. str.* However, because only a few Australasian species were included in the analyses of Kadereit *et al.* (2003, 2005, 2010) and Fuentes-Bazan *et al.* (2012a, 2012b), the phylogenetic resolution for these taxa remained insufficient (see below). In our opinion, key Eurasian taxa of *Chenopodium* that may possibly be related to Australian taxa were also not sampled in Fuentes-Bazan *et al.* (2012a, 2012b).

The new important findings that resulted from the molecular phylogenetic study by Walsh *et al.* (2015) are discussed below.

### **Considerations on relationships of some Australian taxa of *Chenopodium* (incl. *Rhagodia*) and their possible Eurasian relatives**

As we mentioned above, close links between *Rhagodia*, *Einadia* and some Australian taxa usually placed in *Chenopodium* were noted and discussed by several authors well before the advent of molecular phylogenetic methods. These suggestions were confirmed by recent molecular studies. However, we were unaware of earlier hypotheses directly linking Australian endemic taxa of *Chenopodium s. lat.* with their possible Eurasian relatives, except for some rather general assumptions.

The possible links of Australian endemic taxa to Eurasian annual *C. vulvaria* L. and subshrubby *C. frutescens* (both species having the peculiar trimethylamine smell, often described as that of ‘rotten fish’) were already suggested and considered by Mosyakin (2003b: 216), who provided the following discussion (in Ukrainian, here given in English translation): ‘The exclusively Australian sections *Polygonoidea* Aellen (1964, Feddes Repert. sp. nov. 69: 69) and *Desertorum* P.G. Wilson (1983, Nuytsia 4(2): 151) are not discussed here in detail because at present there is not enough data on their relationships and taxonomic peculiarities sufficient for a reliable phytogeographic analysis. It should be noted, however, that species of sect. *Desertorum*, despite their morphological features (for example, tendency to form fleshy fruits, similar to those in the genus *Rhagodia*), are evidently close to Eurasian species related to *C. vulvaria* and *C. frutescens* (see also discussion of subsect. *Chenopodium*). Thus, most probably, sect. *Desertorum* can be regarded as a result of ancient migration of ancestral Asian species due to a long-distance dispersal event and their further adaptive evolution under specific conditions of arid interior regions of Australia’.

It should also be stated that *C. frutescens* can be viewed as a morphological link between *C. vulvaria*, with which it shares the trimethylamine smell and similar leaf shape, and the group of *C. acuminatum* (sect. *Acuminata* Ignatov) in regards to the similar leaf shape and structure, and the linear inflorescences. The trimethylamine smell seems to occur mainly in early-branching clades of *Chenopodium*; however, several other Australasian, Eurasian and American taxa also have the same or similar odour (but usually not as strong as in *C. vulvaria*, sometimes barely perceptible) and because of that the phylogenetic importance of that biochemical character remains obscure.

Mosyakin (2003a, 2003b) also discussed possible links between taxa of *C. sect. Auricoma* Aellen and sect. *Acuminata*: ‘The Australian section *Auricoma* Aellen, which is represented by two endemic Australian species, shrubby *C. auricomum* and annual *C. auricomiforme* Murr & Thell., is characterised by both vesicular farinose and tubular multicellular trichomes, which are located mainly on branches of inflorescences (Carolin 1983; Wilson 1983, 1984). The presence of this rare character, as well as narrowly elliptic, ovate or slightly trilobate leaves with semitranslucent margins, indicates that sect.

*Auricoma* is to some extent related to sect. *Acuminata*. The latter (section) is represented in Asia by *C. acuminatum* and its close relative *C. vachellii* Hook. & Arn. Thus, these two groups (sections) form together an Australasian type of distribution, which is reasonable from the phytogeographical viewpoint. However, the phytogeographic and phylogenetic significance of these links still remains insufficiently explained. We can logically assume migration scenarios of Asian taxa southward or of Australian taxa northward. In my opinion, the first scenario is more realistic. As it has been emphasised by P.G. Wilson (Wilson 1983), the Australian section is very similar to sect. *Chenopodium* (which was reported by Wilson under the erroneous name, as sect. *Leprophyllum* s. lat., including almost all subdivisions of subgen. *Chenopodium*), especially if sect. *Auricoma* includes *C. auricomiforme*, which is a connective link between these two groups.

In my [SLM] opinion, '*C. auricomiforme*, which occurs in the eastern part of Australia (SE Queensland and NE New South Wales), is indeed transitional, but toward sect. *Acuminata*, not to sect. *Chenopodium*. Its distribution in Australia is also noteworthy. This species does not occur in extreme arid regions of Australia, where *C. auricomum* occurs. A similar situation is observed also in Asia, where typical *C. acuminatum* is widespread in continental arid habitats from Central Asia to the south-easternmost Europe, mainly within the Irano-Turanian region in a wide sense, while *C. vachellii* is a species of more humid regions and often littoral habitats of Eastern and South-eastern Asia. We can assume that littoral Asian species in the past migrated to Australia, and the shrubby habit evolved in plants of that group during their isolation and colonisation of the inner parts of the island continent as an adaptation in response to arid habitat conditions' (translated from Ukrainian: Mosyakin 2003a: 27; see also further details in Mosyakin 2003b: 218–220). Mosyakin (in Zhu *et al.* 2003: 380) also commented that 'judging from the presence of characteristic multicellular hairs (especially in the inflorescence) and leaf and inflorescence morphology, *C. acuminatum* s.l. (*C. sect. Acuminata* Ignatov) is related to the Asian perennial *C. fruticosum* [a typo – should be *C. frutescens*] C.A. Meyer, the Australian shrubby *C. auricomum* Lindley (the latter, together with the annual *C. auricomiforme* Murr, is placed in *C. sect. Auricoma* Aellen), and probably to some other shrubby species'.

The peculiar linear multicellular trichomes present on inflorescence branches of the Australian and Asian taxa seem to be an important morphological synapomorphy of sections *Acuminata* and *Auricoma*. This character was observed in Australian *C. auricomum* and *C. auricomiforme* (Aellen 1960–1961: 572; Wilson 1983, 1984) and Eurasian *C. acuminatum* (Aellen 1960–1961: 572) and *C. vachellii* (Iljin & Aellen 1936: 59). These trichomes were termed 'tubular hairs' by Aellen (1960–1961: 572; 'Schlauchhaare' in German), 'contorted tubular multi-cellular hairs' by Wilson (1983: 138), and 'sausage-like hairs' ('колбасовидные волоски' in Russian) by Iljin and Aellen (1936: 59) and Ignatov (1988: 18–19).

Mosyakin (2003a, 2003b) was not the first who noted the close similarity between *C. auricomum* and *C. acuminatum*. Bentham (1870: 159) provided the following comment under *C. auricomum*: 'This species undoubtedly comes near to some forms of *C. album*, differing in its entire more tomentose leaves and larger flowers. It appears to be still more closely allied to and perhaps not really distinct from the East Asiatic *C. acuminatum*, Willd.' Of course, the shrubby Australian *C. auricomum* is definitely not conspecific with annual *C. acuminatum* (and also not close to *C. album*), but that note was probably explained by the fact that Bentham had at his disposal only limited material of both these species. Wilson (1983, 1984) rejected Bentham's suggestion of conspecificity of *C. auricomum* and *C. acuminatum* but refrained from proposing any concept of their possible relationships.

A new molecular phylogenetic study (Walsh *et al.* 2015) brought additional noteworthy conclusions involving Australian taxa; these conclusions are important for our further discussion and deserve to

be cited here in full:

The ‘Vulvaria & Auricomum’ clade is sister to the rest of *Chenopodium* and consists of *C. vulvaria* (European, but currently widely dispersed) and *C. auricomum* (Australian). Resolution of the basal nodes within the *Chenopodium* clade are fully congruent with, yet better resolved than, the results observed in previous analyses that used ITS and plastid sequence data (Fuentes-Bazán *et al.*, 2012a, b). That is, our phylogenetic results support the recent taxonomic segregation of parts of *Chenopodium* s.l. into other genera. One difference, however, is that there is strong support in our *SOSI* results linking *C. vulvaria* and *C. auricomum* in a clade that is the sister group of a clade comprising all other members of *Chenopodium* s.s. Several previous studies using plastid markers (Kadereit *et al.*, 2003, 2005, 2010) found that Australian and New Zealand *Chenopodium*, including *C. auricomum*, group together in a clade with species of *Rhagodia* R.Br. and *Einadia* Raf., to the exclusion of *Chenopodium* species from other continents. The ITS sequence data of Fuentes-Bazán *et al.* (2012a, b), on the other hand, found that *Rhagodia* and *Einadia* did not group in a clade, but were unresolved within a clade otherwise composed of *Chenopodium* (core-*Chenopodium* clade), itself sister to *C. vulvaria*. Based solely on the ITS phylogeny, a taxonomic revision was proposed subsuming *Rhagodia* and *Einadia* into *Chenopodium* to make *Chenopodium* monophyletic (Fuentes-Bazán *et al.*, 2012a). Our results suggest an alternative relationship among the Australian genera and *Chenopodium*. That is, if *C. auricomum* is indeed representative of the broader Australian–New Zealand clade, we predict that if *Rhagodia* and *Einadia* species were included in this analysis, they would form an entirely Australian–New Zealand clade with *C. auricomum*, sister to *C. vulvaria*, together forming a distinct clade sister to the remaining *Chenopodium* s.s. species. We suggest that more studies are needed to determine whether subsuming *Rhagodia* and *Einadia* into *Chenopodium* is appropriate. If *Rhagodia* and *Einadia* are indeed embedded within *Chenopodium* s.s., this will have interesting implications, because *Rhagodia* and *Einadia* differ from *Chenopodium* in having fruit in the form of fleshy berries, perennial shrub habit, and unisexual flowers (Brown, 1810) (Walsh *et al.* 2015: 541).

In our opinion, the recognition of the early-branched clade (or clades?) of *Chenopodium* as a separate genus (most probably under the priority name *Rhagodia*), as it was cautiously suggested by Walsh *et al.* (2015) as one of possible solutions, is hardly justified, especially considering the close links between the Australian and Eurasian taxa and their morphological similarities (see above). Most probably several subgroups/subclades corresponding to re-circumscribed sections will be revealed within the lineage currently informally called the ‘Vulvaria & Auricomum’ clade (Walsh *et al.* 2015).

*Chenopodium acuminatum* and *C. vachellii* (‘*C. virgatum*’ *auct. p.p., non* Thunb.) are currently included in *C. sect. Acuminata* (Ignatov 1988; Mosyakin 1996, 2003a); however, supposedly related Australian taxa were placed in several (at least three) sections of *Chenopodium* and in two segregate genera (Wilson 1983, 1984). No formal taxonomic placement in any infrageneric taxon outside of *C. sect. Chenopodium* was proposed by anyone for the phylogenetically important group of *C. vulvaria* (including *C. rhombicum* (Murr) F.Dvořák, *C. nidorosum* Otschiauri, and some other taxa, which are hardly specifically different from it) and its few possible Eurasian relatives. Mosyakin (2003a: 29) noted earlier that *C. vulvaria* and the supposedly closely related group of poorly known (and most probably relict) mountain species from Asia require special attention and formal taxonomic recognition, probably as a separate subsection (or two subsections). Standley (1916) had earlier segregated *C. vulvaria* (together with two American species) in an unranked infrageneric group, which is validly published but inoperative in questions of priority except for homonymy; it can be used as a basionym or replaced synonym for subsequent new combinations, names at new ranks, or replacement names in definite ranks (ICN Art. 37.3: McNeill *et al.* 2012). This group can be now formally recognised as a section, which is validated below.

It should be noted that the North American taxa *C. watsonii* A. Nelson and *C. parryi* Standl., which Standley (1916) also placed in his ‘*Vulvariae*’ group, should be excluded from it because they are not closely related to *C. vulvaria*, judging from morphological, biogeographical (Mosyakin & Clemants 1996; Clemants & Mosyakin 2003, and references therein), and now also molecular phylogenetic (Walsh *et al.* 2015) evidence. In particular, Mosyakin and Clemants (1996: 401) placed *C. watsonii* s. lat. in *C.* sect. *Chenopodium* subsect. *Favosa* (Aellen) Mosyakin & Clemants but also indicated that this species aggregate, ‘evidently being related to *C. berlandieri*, at the same time closely approaches morphologically some forms of the *C. fremontii* aggregate, and possibly may be included together with the latter in *Chenopodium* subsect. *Fremontiana*’. Walsh *et al.* (2015) revealed the diploid *C. watsonii* in the mainly American ‘Genome A’ clade containing, for example, North American diploids *C. standleyanum* Aellen, *C. fremontii* S. Watson, *C. leptophyllum* (Moq.) Nutt. ex S. Watson (with only ‘A-genome’ homeologs), tetraploid *C. berlandieri* Moq. (having also ‘B-genome’ homeologs), and South American tetraploids *C. quinoa* Willd. and *C. hircinum* Schrad. (also combining in their genome A and B homeologs) etc., but also East Asian diploid *C. bryoniifolium* Bunge and probably some other Asian taxa, although relationships within this clade remain poorly resolved.

We prefer here to leave *C. frutescens* yet unplaced in any section because of its characters being transitional between those of members of the *Acuminata* and *Vulvaria* groups. Morphology indicates that *C. frutescens* is probably closer to *C. acuminatum*, having similar leaves and inflorescences, but since easily observable morphological traits in Chenopodiaceae can be misleading (see above), we should wait for solid molecular evidence. The same is true for other supposed Asian relatives of *C. vulvaria*; they may represent other early-branching lineages not yet revealed in the available molecular phylogenetic studies.

### Taxonomy

After confirming phylogenetically rooted positions of taxa of *Rhagodia* and *Einadia* within the clade of *Chenopodium* s. str., Fuentes-Bazan *et al.* (2012a) made nomenclatural transfers of species of these two Australian genera to *Chenopodium*. When doing that, they coined three illegitimate combinations which are later homonyms of earlier names (ICN Art. 53.1: McNeill *et al.* 2012). One of those illegitimate combinations, *C. crassifolium* (R.Br.) S. Fuentes & Borsch, *comb. illeg.*, was soon noticed and the new replacement name *C. wilsonii* S. Fuentes, Borsch & Uotila has been published (Fuentes-Bazan *et al.* 2012b).

For two other combinations, *C. hastatum* (R.Br.) S. Fuentes & Borsch, *comb. illeg.* and *C. latifolium* (Benth.) S. Fuentes & Borsch, *comb. illeg.*, there are no correct names under *Chenopodium* currently available. As such, we propose here new names for these species.

The herbarium acronyms are given following *Index Herbariorum* (Thiers continuously updated). Online images of types and other specimens were consulted using *Global Plants* (<https://plants.jstor.org>) and online resources of corresponding herbaria.

#### ***Chenopodium robertianum* Iamónico & Mosyakin, *nom. nov.***

*Rhagodia hastata* R.Br., *Prodr. Fl. Nov. Holland.*: 408 (1810). ≡ *Einadia hastata* (R.Br.) A.J. Scott, *Feddes Repert.* 89: 4 (1978). ≡ *Chenopodium hastatum* (R.Br.) S. Fuentes & Borsch, *Molec. Phylogen. Evol.* 62: 372 (2012) (as ‘*hastata*’), *comb. illeg.*, *non C. hastatum* Phil., *Fl. Atacam.*: 47 (1860); *nec C. hastatum* Dumort., *Bull. Soc. Roy. Bot. Belgique* 4: 339 (1865), *nom. illeg.*; *nec C. hastatum* St.-Lag., *Étude Fl.*, ed. 8 [A. Cariot] 2: 703 (1889), *nom. illeg.*; *nec C. hastatum* (C. Klinggr.) Murr, *Magyar*

*Bot. Lapok* 1: 360 (1902), *nom. illeg.* *Type*: Port Jackson, New South Wales, Australia, *R. Brown s.n.* [Bennett No. 3040] (*lectotype fide* A.J. Scott, *Feddes Repert.* 89: 4 (1978): BM 001010211 image seen; *isoelectotypes*: BM 001015889 image seen, K 000898399 [plant of the bottom-half of the sheet] image seen, MEL 545196 image seen).

*Etymology.* The newly proposed epithet commemorates Robert Brown (1773–1858), an outstanding British botanist and pioneer of Australian plant taxonomy, who authored the replaced name. We prefer not to use the epithet ‘*brownii*’ because of the existing name *C. brownianum* Schult. (published as ‘*browneanum*’, a replacement name for *C. lanceolatum* R.Br. 1810, *nom. illeg., non* Willd. 1808), following *ICN* Art. 23, Rec. 23A.2 (McNeill *et al.* 2012), according to which the use of the genitive and the adjectival form of the same word to designate two different species of the same genus should be avoided.

*Notes on typification.* In the protologue, Brown (1810: 408) indicated that he observed living plants at Port Jackson *via* the citation ‘(J.) v. v.’ (meaning ‘Port Jackson, *vidi vivo*’) but did not cite any particular specimen that can be regarded as the holotype (as defined by *ICN* Art. 9.1: McNeill *et al.* 2012). Scott’s (1978a: 4) reference to the specimen from Brown’s own herbarium with a Bennett number of 3040 (BM 001010211) as the ‘holotype’ is an error to be corrected to ‘lectotype’ according to *ICN* Art. 9.9 (McNeill *et al.* 2012).

***Chenopodium benthamii* Iamónico & Mosyakin, *nom. nov.***

*Rhagodia crassifolia* R.Br. var. *latifolia* Benth., *Fl. Austral.* 5: 155 (1870). ≡ *Rhagodia latifolia* (Benth.) Paul G. Wilson, *Nuytsia* 4(2): 228 (1983). ≡ *Chenopodium latifolium* (Benth.) S. Fuentes & Borsch, *Molec. Phylogen. Evol.* 62: 372 (2012), *nom. illeg., non* *C. latifolium* (Wahlenb.) E.H.L. Krause in Sturm, *Deutschl. Fl.*, ed. 2, 5: 174 (1901). *Type*: Dirk Hartog Island, Western Australia, Australia, [21–25 January 1822], A. Cunningham 321 (*lectotype fide* P.G. Wilson, *Nuytsia* 4: 228 (1983): K 000898390 image seen; *isoelectotypes*: K 000898393 image seen; MEL 545194 image seen).

*Etymology.* The newly proposed epithet commemorates George Bentham (1800–1884), an outstanding British botanist and the author of the replaced name.

*Notes on typification.* Bentham (1870: 155) proposed his new var. *latifolia* to distinguish forms of *R. crassifolia* growing on Dirk Hartog Island, which were characterised by having ‘leaves obovate ovate hastate or broadly oblong, all very obtuse and under ½ in. long’. Bentham (1870) also cited ‘*R. crassifolia*, Moq. in DC. Prodr. xiii. ii. 52’ and the collector ‘A. Cunningham’. This citation should be viewed as the direct reference to the updated description by Moquin-Tandon (1849: 52), who accepted Brown’s species name and reported ‘Cunningh.!’ as one of its collectors. Most probably Moquin-Tandon studied in de Candolle’s herbarium (‘v. s. in h. DC.’, meaning G-DC) only the specimen collected by Cunningham (as indicated by the exclamation point) and based his updated description on that specimen. Consequently, Bentham (1870) probably intended to consider Moquin-Tandon’s concept of *R. crassifolia* (as opposed to the original understanding of the species by Brown) as applicable to his new var. *latifolia*.

Allan Cunningham visited Dirk Hartog Island from 21 to 25 January 1822 (Heward 1842: 274–275), and thus all his specimens from that locality were collected during this period. We have traced three germane specimens (K 000898390, K 000898393 [plant on the bottom-half of the sheet]) and MEL 545194), only one of which (K 000898390) reports the collection date (‘*Jan* 1822’). Scott (1978a: 9) cited the

type as ‘Cunningham 321 (K-holo.!)’. Since there are at least two such specimens at K, this should be regarded as a first-step lectotypification. However, Wilson (1983: 228) cited the dated specimen from K as ‘Dirk Hartog Is., Jan. 1822, A. Cunningham 321 (holo: K; iso: MEL)’. By doing that, he explicitly identified this dated specimen as the type, thus in fact providing the second-step lectotypification. His type designation (‘holotype’) is correctable to lectotype under *ICN* Art. 9.9 (McNeill *et al.* 2012).

***Chenopodium benthamii* subsp. *rectum*** (Paul G. Wilson) Iamónico & Mosyakin, *comb. nov.*

*Rhagodia latifolia* (Benth.) Paul G. Wilson subsp. *recta* Paul G. Wilson, *Nytsia* 4(2): 228 (1983). ≡ *Chenopodium latifolium* (Benth.) S. Fuentes & Borsch subsp. *rectum* (Paul G. Wilson) S. Fuentes & Borsch, *Molec. Phylogen. Evol.* 62(1): 372 (2012). *Type*: Victoria District, Geraldton [Western Australia], January 1901, *Diels & Pritzel* 542 [as 212] (*holotype*: PERTH 01567128 image seen).

### Updated citations of infrageneric taxa and validation of a new section

The names of infrageneric entities *Auricoma* and *Acuminata*, here recognised as sections, were initially published invalidly and because of that they were sometimes cited with incorrect places of their valid publication, and incorrect ranks and authorship. For that reason we provide below their updated nomenclatural citations.

***Chenopodium* sect. *Acuminata*** Ignatov, *Sosud. Rast. Sovet. Dal'nego Vostoka* [*Pl. Vasc. Orient. Extrem. Sov.*] 3: 18 (1988). *Chenopodium* sect. *Chenopodia* C.A. Mey. ser. *Acuminata* Aellen & Iljin, *Fl. URSS* 6: 56 (1936), *nom. inval., descr. ross.*; *Chenopodium* sect. *Chenopodium* subsect. *Acuminata* Aellen in Hegi, *Ill. Fl. Mitt.-Eur.*, 2<sup>nd</sup> edn, 3(2): 578 (1961), *nom. inval., descr. germ.*

*Type*: *C. acuminatum* Willd.

*Species*: *C. acuminatum* Willd., *C. vachellii* Hook. & Arn. (*C. acuminatum* var. *vachellii* (Hook. & Arn.) Moq., *C. tonkinense* Courchet, *C. virgatum* auct. non Thunb.; *C. acuminatum* subsp. *virgatum* auct. non (Thunb.) Kitam.); probably also *C. frutescens* C.A. Mey. (now unplaced in any section pending further research; see discussion above).

The application of the name *C. virgatum* Thunb. (not *C. virgatum* (L.) Ambrosi, *nom. illeg.* = *Blitum virgatum* L.) remains problematic. Zhu *et al.* (2003: 380) noted that ‘there was much controversy regarding the taxonomic affiliation of *C. virgatum*: some authors believed that the name refers to narrow-leaved forms of the *C. album* aggregate or to *C. strictum*’. We follow here the concept of *C. virgatum* as accepted by Aellen (1960–1961), Uotila (2001), and some other authors, who considered this taxon a member of the *C. album* aggregate.

***Chenopodium* sect. *Auricoma*** Aellen, *Feddes Repert.* 69: 69 (1964). Aellen in Hegi, *Ill. Fl. Mitt.-Eur.*, 2<sup>nd</sup> edn, 3(2): 577 (1961), *nom. inval., descr. germ.*

*Type*: *C. auricomum* Lindl.

*Species*: *C. auricomum* Lindl., *C. auricomiforme* Murr & Thell.

***Chenopodium* sect. *Vulvaria*** (Standl.) Mosyakin & Iamónico, *comb. nov.*

*Chenopodium* [infragen. unranked] *Vulvariae* Standl., *N. Amer. Fl.* 21(1): 20 (1916).

*Type*: *C. vulvaria* L.

*Species*: *C. vulvaria* L. s. lat. (incl. *C. nidorosum* Otschiauri, *C. rhombicum* (Murr) F.Dvořák; probably also some other insufficiently known taxa; see discussion above).

*Note*: Following ICN Art. 21.2 and 32.2 (McNeill *et al.* 2012), the ending of the sectional name is changed as compared to that of the group name originally published by Standley (1916).

### Concluding remarks

It can be thus assumed that the major diversity of Australian endemic taxa of *Chenopodium* (including *Rhagodia* and *Einadia*) was formed mainly as a result of one or a few dispersal events of Eurasian taxa from or *via* southeastern Asia (probably using coastal/littoral pathways), following one of scenarios outlined and generalised in Kadereit *et al.* (2005) for other Australian taxa of Chenopodiaceae. Judging from available data on morphology and biogeography, the link between sections *Acuminata* and *Auricoma* is probably explained by an independent migration event, so there were at least two independent cases of dispersal from Asia to Australia.

It is also noteworthy that the biogeographic and phylogenetic patterns observed in *Chenopodium* are very similar to some patterns revealed for Australian taxa of Camphorosmeae (Cabrera *et al.* 2009, 2011; Kadereit & Freitag 2011; Kadereit *et al.* 2014): a dispersal of some early-branching group followed by its explosive evolutionary radiation under conditions of the arid island continent characterised by extreme environmental conditions and potentially free ecological niches suitable for colonisation by the newcomers. It is indeed amazing that the whole great morphological diversity of Australian Camphorosmeae fitted into just one ‘*Sclerolaena* subclade’ sister to the Central Asian ‘*Bassia dasyphylla* subclade’; the latter is now recognised as the genus *Grubovia* Freitag & G.Kadereit, with just three currently accepted species (Kadereit & Freitag 2011).

There are also some biogeographic and taxonomic parallels with Australian Salicornioideae Ulbr. (see Shepherd *et al.* 2004; Shepherd *et al.* 2005; Piirainen *et al.* 2017), where several previously recognised and morphologically diverse Australian genera were subsumed under *Tecticornia* Hook.f. (Shepherd & Wilson 2007), similar to what has now happened to *Rhagodia* and *Einadia* subsumed under *Chenopodium*. In evolution of all these groups in Australia, long-distant dispersal or stepping stone migrations of a limited ancestral stock (probably *via* coastal habitats) and further explosive radiation were involved. The coastal migrational pathways seem to be especially evident in Salicornioideae, mainly because of the hygrohalophytic nature of the group.

The exceptional biogeographic, evolutionary and ecological role of littoral/coastal/alluvial habitats in shaping the desert floras and some of their ‘iconic’ taxa (including Chenopodiaceae) was especially well outlined by Iljin (1937, 1947, 1958; see also discussion in Kühn 1993; Mosyakin 2002, 2003b; Feodorova 2009, and references therein). Since then, Iljin’s concept (of which many Western researchers were fully unaware because it was published in Russian in little-known journals and serials) received solid confirmations from several molecular phylogenetic studies cited above. Similar ideas about the role of coastal/littoral habitats in the evolution of the Australian desert flora (including at least some representatives of Chenopodiaceae) were expressed by Burbidge (1960). Various opinions (sometimes conflicting ones) on Burbidge’s assertions were further discussed in many fundamental publications

on Australian plant geography (Barlow 1981; Carolin 1982; Parr-Smith 1982; Hill *et al.* 1999; Crisp *et al.* 1999 etc.; summarised by Murphy & Crayn 2017 and Ebach 2017).

For at least a few deviant taxa of Australian *Chenopodium*, different scenarios may exist. In particular, exceptional long-distance migration events from other directions (probably even from South America?) cannot be excluded as well (see case studies of long-distance migrations in Cain *et al.* 2000; Winkworth *et al.* 2002; Mosyakin *et al.* 2007; Stuessy *et al.* 2014, and references therein; Winkworth *et al.* 2015, and references therein). For example, possible relationships of *C. detestans* Kirk remain obscure. This species, known mainly from New Zealand (and reported as a rare and probably introduced plant in Australia), was often compared to *C. vulvaria*, partly because of its fetid odour and somewhat similar leaf shape, but Wilson (1983) suggested its affinity with mainly South American (extending northward to Mexico) *C. carnosulum* Moq. and *C. scabriceale* Speg. Considering the documented cases of long-distance dispersal between South America and New Zealand (Winkworth *et al.* 2002; Winkworth *et al.* 2015) and the rarity and possible non-native status of *C. detestans* in Australia, both these alternative scenarios should be considered and eventually tested by molecular approaches. We have seen too few specimens of *C. detestans* to make any morphology-based assumptions regarding its possible relationships.

Based on available evidence discussed above, we can make the following predictions and recommendations: (1) Most taxa of *Chenopodium s. str.* (including *Rhagodia* and *Einadia*) endemic to Australia and New Zealand are probably related to Eurasian taxa of the early-branching clade (or clades) within *Chenopodium s. str.*, forming together a clade (or a grade consisting of two to several clades?) sister to all other members of *Chenopodium*. (2) Any further dedicated molecular phylogenetic studies of Australian taxa of *Chenopodium* (those placed by various authors in sections *Auricoma*, *Desertorum*, *Polygonoidea*, *Rhagodioides*) should also involve not only Australian taxa earlier placed in *Rhagodia* and *Einadia*, but also, for comparison, the supposedly related Eurasian species, especially *C. vulvaria* (sect. *Vulvaria*), *C. frutescens* (currently unplaced in any section), and *C. acuminatum* and *C. vachellii* (sect. *Acuminata*). (3) To exclude (or, less probably, reveal?) some other scenarios of relationships and migration of some species, a comparative analysis of selected South American and some insular species, such as Hawaiian *C. oahuense* (Meyen) Aellen (= *C. sandwicheum* Moq.) and Juan Fernándezian taxa, would be desirable. Addition of *C. mucronatum* Thunb. may also be useful; however, judging from its morphology and biogeography, this southern African species is closer to other African taxa, such as *C. olukondae* (Murr) Murr and *C. ugandae* (Aellen) Aellen, related to *C. opulifolium* Schrad. ex W.D.J. Koch & Ziz. (the latter is presumably of Mediterranean–Central Asian origin, but evidently with African relatives). (4) As it stands now, the best taxonomic solution seems to be the inclusion of *Rhagodia* and *Einadia* in *Chenopodium*. (5) Infrageneric units (mainly sections) of *Chenopodium* will be most probably somewhat re-circumscribed to outline monophyletic groups within the genus, based on new molecular and morphological evidence.

Answers to the remaining intriguing questions of taxonomy, phylogeny and biogeography of Australian taxa of *Chenopodium* will be given by further molecular phylogenetic research. However, these phylogenetic studies should be accompanied by parallel morphological, biogeographical, ecological and other studies, and the voucher specimens sampled for molecular analysis should have reliable morphology-based identifications.

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## A revision of the *Lasiopetalum floribundum* group (Malvaceae), including recognition of four new species

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### Abstract

Shepherd, K.A. & Wilkins, C.F. A revision of the *Lasiopetalum floribundum* group (Malvaceae), including recognition of four new species. *Nuytsia* 28: 273–298 (2017). This revision focuses on *Lasiopetalum floribundum* Benth. and six morphologically allied Western Australian species. This group is characterised by loose dichasial or monochasial inflorescences comprising small, pink or white flowers subtended by a narrow, non-petaloid, epicalyx bract and having reflexed, stellate hairs on the style. Three new species of conservation significance from east and north of Perth are named as *L. caroliae* K.A. Sheph., *L. rutilans* K.A. Sheph. & C.F. Wilkins and *L. moullean* K.A. Sheph. & C.F. Wilkins, and a new species from the Margaret River region, *L. occidentale* K.A. Sheph. & C.F. Wilkins, is also recognised. Revised descriptions are provided for *L. floribundum* (which is lectotypified), *L. glabratum* Paust and the Threatened species *L. pterocarpum* E.M. Benn. & K.A. Sheph. A key to the group is included along with images and distribution maps.

### Introduction

*Lasiopetalum* Sm. is an endemic Australian genus in the tribe *Lasiopetaleae* J. Gay (subf. Byttnerioideae Burnett, Malvaceae Juss.) (Stevens 2001; Whitlock *et al.* 2001; Bayer & Kubitski 2002) characterised by a lack of stipules, a lack of prominent ribs on the petaloid calyx, petals being either absent or reduced to scales, and poricidal anther dehiscence (Grieve 1998; Wilkins & Whitlock 2015). Largely confined to southern Australia, the genus extends northward to Shark Bay on the west coast and to the Blackdown Tableland in Queensland.

*Lasiopetalum* has not been revised in full since Bentham's treatment in *Flora Australiensis* (1863), although in recent decades 12 new species have been described (Paust 1974; Shepherd *et al.* 2006; Bennett & Shepherd 2007; Meissner *et al.* 2014), and *L. laxiflorum* (Benth.) F. Muell. and *L. glutinosum* (Lindl.) F. Muell. have been reinstated (Shepherd & Wilkins 2015). This brings the total number of formally described species in the genus to 35; however, there remain at least 12 potentially new taxa that require taxonomic resolution, many of which are of conservation concern (Western Australian Herbarium 1998–; CHAH 2006–).

Following a revision of the rostrate anther group of *Lasiopetalum* (Shepherd & Wilkins 2015), this paper is one in a series that will serve to name and revise species in Western Australia, initially focusing on taxa that were previously included in *Lasiopetalum* sect. *Corethrostylis* (Endl.) Benth. (basonym *Corethrostylis* Endl.). The section *Corethrostylis* was originally distinguished by the presence of stalked and reflexed stellate hairs that form a dense, white, 'cylindrical or conical mass' along the length of the style (Bentham 1863); however, it is evident that this character is variable and as such the section is no longer accepted. This account focuses on *L. floribundum* Benth. and six allied species (the *L. floribundum* group).

## Methods

The methods for examining specimens and mapping follow Shepherd and Wilkins (2015). Stellate hairs in the *L. floribundum* group fall into two categories, those with the arms fused such that the hair is scale-like (Figure 1A) and those with free arms (Figure 1B). The radiation of the free arms may be multiangulate (in all directions) or rotate (in one plane), as defined and illustrated in Hewson (1988: 18, Figure 3K). In the following descriptions, stellate hairs have multiangulate arms unless otherwise stated. Indumentum density is defined here as 'tomentose' when the hairs are very densely arranged and the epidermis obscured, 'dense' when hairs are overlapping but the epidermis is visible, 'moderately dense' when hairs are touching laterally, and 'scattered' when the hairs are well-separated. Scanning Electron Microscope (SEM) images were produced using a Jeol Neoscope JCM 5000 bench top machine with material coated in gold using a Smart-Coater. Images of type material were viewed via *Global Plants* (<https://plants.jstor.org/>).

## Taxonomy

The *L. floribundum* group of species share the following combination of characters: *leaves* ovate to broadly ovate or orbicular, with the base cordate; *stipules* absent; *inflorescence* a loose monochasial or dichasial cyme; *epicalyx bract* single, non-petaloid, linear to narrowly oblong; *calyx* pale to bright pink (rarely white) without prominent ribs, with the inner surface dark red at base, or green and dark red; *petals* absent; *anthers* 5, deep red, glabrous, ovate to elliptic with an obtuse apex with introrse dehiscence of white pollen from apical pores; *ovary* 3-carpellate with two ovules per carpel; *style* filiform with a cone of dense, white, fan shaped, reflexed, stellate hairs along most of its length.

### Key to species in the *Lasiopetalum floribundum* group

1. Margin of mature leaves multilobed, abaxial surface with a tomentum of stellate hairs; ovary and fruit winged between carpel fusion lines (Serpentine National Park)..... **L. pterocarpum**
- 1: Margin of mature leaves entire, irregular or trilobed (rarely multilobed), abaxial surface with scattered to dense stellate hairs; ovary and fruit without wings
  2. Procumbent, trailing subshrub; stem, inflorescence and outer calyx indumentum of scale-like hairs with some stellate hairs; mature leaf blades usually <4 mm long, orbicular to broadly ovate, apex rounded (Bindoon to Toodyay; NE of North Bannister)..... **L. caroliae**
  - 2: Erect subshrub to shrub; stem, inflorescence and outer calyx indumentum of multiangulate stellate hairs only; mature leaf blades usually >4 mm long, broadly ovate to narrowly ovate, apex acute to acuminate
    3. Mature leaves coriaceous and stiff; abaxial leaf surface glabrous or with scattered, stellate hairs on veins, each with arms to 0.3 mm long (Bullsbrook to North Bannister)..... **L. glabratum**

- 3: Mature leaves soft and pliable; abaxial leaf surface with a scattered to moderately dense indumentum of stellate hairs, each with arms 0.6–0.8 mm long
4. Pale brown, golden or ferruginous (rarely purple-red), stellate hairs present on new growth of the stem, pedicels and peduncle; calyx lobes 0.7–1.1 mm wide, base dark red
5. Mature leaves entire, multilobed or sinuate; inflorescence usually with  $\geq 10$  flowers per inflorescence (Bullsbrook to Walpole and E to Boat Harbour)..... **L. floribundum**
- 5: Mature leaves always distinctly trilobed; inflorescence always with  $< 10$  flowers (Margaret River region)..... **L. occidentale**
- 4: Bright red, stellate hairs evident on new growth of the stem, pedicels and peduncle; calyx lobes 1.4–2.3 mm wide, base dark red with green at junction of lobes
6. Abaxial leaf surface with two layers of stellate hairs (large and small); calyx lobes 1.4–1.7 mm wide, inner surface with stellate hairs; aril a cream-brown cap with 2–5 arms, 1.6–2.3 mm long (Kellerberrin–Kwolyin area)..... **L. moulllean**
- 6: Abaxial leaf surface with one layer of large stellate hairs; calyx lobes (1.7–)2–2.8 mm wide, inner surface glabrous; aril a white cap with 2 arms, c. 1.3 mm long (Mt Lesueur area) ..... **L. rutilans**

***Lasiopetalum caroliae* K.A.Sheph., *sp. nov.***

*Type:* Bindoon Training Area, Western Australia [precise locality withheld for conservation reasons], 1 November 2005, *F. Hort* FH 2668 (*holo:* PERTH 07308264; *iso:* CANB, K, MEL).

*Lasiopetalum* sp. Toodyay (F. Hort 2689), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au> [accessed 30 August 2016].

*Lasiopetalum exiguum* E.M.Benn. & K.A.Sheph. ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au> [accessed 30 August 2016]; G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 543 (2000), *nom. inval.*

Procumbent, sprawling *subshrub*, 0.08–0.4 m high, 0.15–0.2 m wide, with some trailing stems up to 1.45 m long. *Young stems* densely hairy to tomentose, with occasional to scattered, off-white or pale tan,  $\pm$  rotate and multiangulate stellate hairs with 6–8 arms, each to 1–2 mm long, over dense, white with pale tan-centred, scale-like, stellate hairs with 10–22 fused arms, each to 0.2 mm long, glandular hairs absent or occasional to 0.8 mm long; mature stems red-brown, glabrescent. *Petioles* 0.4–2.5(–7.8) mm long, indumentum as for young stems. *Mature leaf blades* scarcely coriaceous, orbicular to broadly ovate, scarcely discoloured, (0.8–)1.5–4(–6) mm long, (0.8–)1.7–4.5(–6) mm wide, base strongly cordate, apex rounded; margins entire, flat or scarcely recurved; abaxial surface glabrous or with scattered, white with pale brown-centred, stellate hairs with 5–7 arms, each to 0.5 mm long; adaxial surface glabrous or with scattered, white with pale tan-centred, stellate hairs with 6–10 arms, each to 0.8 mm long, glandular hairs absent, glabrescent. *Inflorescence* a loose monochasium or dichasium, 21–85 mm long, with (4–)6–8(–13) flowers; *peduncles* (8–)23–33 mm long, with or without occasional stellate hairs with c. 6 arms, each to 0.7 mm long, over scattered to dense, scale-like, stellate hairs with c. 20 arms, each to 0.1 mm long and occasional multicelled, glandular hairs to 2.1 mm long. *Pedicels* 0.8–3.5 mm long, indumentum as for peduncles. *Bract* oblong or narrowly obovate, (0.3–)0.9–1.3 mm long, 0.15–0.5 mm wide. *Epicalyx bract* attachment at base of the calyx (0.5–1 mm below), green or dark red, oblong, narrowly oblong or filiform, 0.6–0.8 mm long, 0.1–0.2 mm wide; abaxial and adaxial surface with white, apical, stellate hairs with 6–20 arms, each

to 0.8 mm long, and occasional scale-like, stellate hairs 0.15 mm diam. *Calyx* pale to bright mauve-pink, base dark red, 3.6–5.7 mm long with a tube 0.5–0.6 mm long; lobes narrowly ovate or narrowly elliptic, 3–5.7 mm long, 0.7–2.3 mm wide, apex acute; outer surface with dense, white, scale-like, stellate hairs with 8–12 fused arms, each to 0.2 mm long, and scattered to moderately dense, white, glandular hairs to 0.3 mm long; inner surface glabrous or with scattered, white, stellate hairs with 1–6 arms, each to 0.15 mm long. *Staminal filaments* 0.2–0.3 mm long, 0.2 mm wide. *Anthers* ovate, red-purple, 1.4–2.3 mm long, 0.6–0.8 mm wide. *Ovary* 0.8–1 mm long, 0.8–1 mm wide; outer surface with dense, white, stellate hairs to 0.3 mm long. *Style* 2.8–3.5 mm long. *Fruit* ellipsoid, 4.1–4.5 long, 4.2–4.5 mm wide, with moderately dense, white, stellate hairs throughout, glandular hairs absent. *Seed* ellipsoid, dull, brownish black, 1.9–2.2 mm long, 0.9–1 mm wide, covered in scattered, white, stellate hairs; aril a cream cap with two short arms, 0.7 mm long, c. 1.1 mm wide. (Figures 1A, 2)

*Diagnostic features.* *Lasiopetalum caroliae* is distinguished from morphologically similar species by the following combination of characters: a delicate, straggling habit; small, orbicular to broadly ovate mature leaves usually <4 mm long, with a rounded apex; scale-like, stellate hairs on the stem, pedicels, peduncle and outer surface of calyx (Figure 1A).

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 23 Sep. 1987, *Anon. s.n.* (PERTH 02714957); 26 Sep. 2007, *E. Bennett* 37 (PERTH); 3 Dec. 2008, *A. Crawford* 1909 (K, PERTH); 10 Oct. 2012, *S.A. Dalglish & J.M. Collins* ELA 2 (PERTH); 1 Oct. 2001, *M. Hislop* 2327 (AD, CANB, PERTH); 6 Apr. 2005, *F. & A. Hort, A. Reavely & N. Willers* 2512 (PERTH); 13 Oct. 2005, *F. B. & J. Hort* 2634 (PERTH); *F. & B. Hort* 2678 (PERTH); 6 Nov. 2005, *F. & J. Hort* 2682 (PERTH); 9 Nov. 2005, *F. Hort* 2689 (PERTH); 27 Sep. 2000, *G.J. Keighery & N. Gibson* 2917 (PERTH); 25 Aug. 2016, *K.A. Shepherd & C.F. Wilkins* KAS 1618 (CANB; PERTH); 24 Feb. 2006, *C.F. Wilkins & F. & J. Hort* CW 2156 (PERTH).

*Phenology.* Flowering from September to November. Fruits observed on specimens collected in December.

*Distribution and habitat.* *Lasiopetalum caroliae* is restricted to a few, scattered populations around Bindoon and Toodyay, in the Wearne State Forest, and north-east of North Bannister (Figure 3) in the Swan Coastal Plain and Jarrah Forest bioregions (IBRA7; Department of the Environment 2013). This species is often found mid-slope on yellow-brown, sandy loam and lateritic gravel soils in *Eucalyptus accedens* woodland or in patches of scrubland or heath.

*Conservation status.* Listed as Priority Three under Department of Parks and Wildlife Conservation Codes for Western Australian Flora by Smith (2017), under the name *L. sp.* Toodyay (F. Hort 2689). While regionally restricted, this species has been recorded as being abundant in some populations.

*Etymology.* This species is named in honour of Dr Carolyn (Carol) Wilkins (1945–), friend and colleague of the first author, in recognition of her indefatigable energy and enthusiasm, which has been particularly valued during many long days shared in the field. Carol has also made a significant contribution to Australian plant taxonomy in the last 20 years having named or revised more than 90 taxa in the *Lasiopetaleae* (Malvaceae) (Meissner *et al.* 2014; Shepherd *et al.* 2006; Shepherd & Wilkins 2015; Whitlock *et al.* 2011; Wilkins 1999, 2005; Wilkins & Chappill 2001a, 2001b, 2002a, 2002b, 2003; Wilkins *et al.* 2008; Wilkins & Whitlock 2005, 2009, 2011a, 2011b, 2015) and various Fabaceae genera (Chappill *et al.* 2007, 2008; Wilkins & Chappill 2007a, 2007b, 2007c; Wilkins *et al.* 2009; Wilkins, Ladd *et al.* 2009; Wilkins *et al.* 2010; Wilkins & Trudgen 2012).

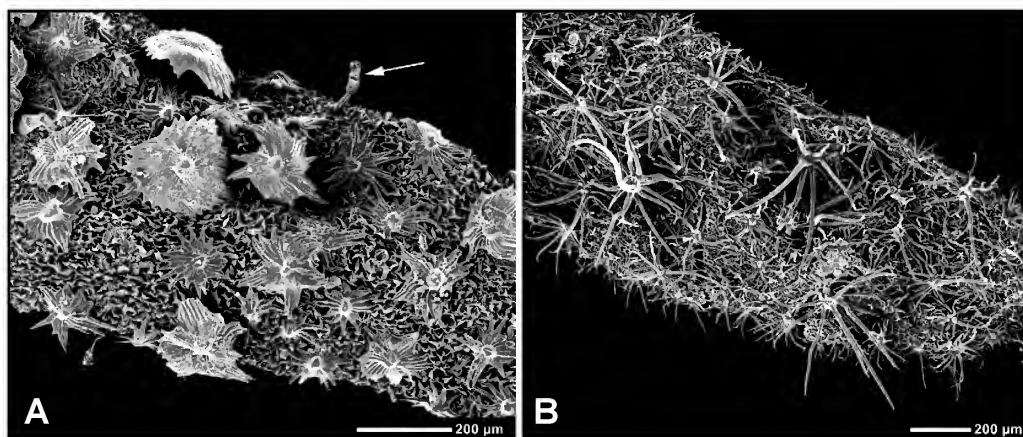


Figure 1. Petiole indumentum. A – *Lasiopetalum caroliae*, showing the distinctive scale-like hairs and scattered glandular hairs (white arrow); B – *L. floribundum*, showing large, scattered, sessile or stalked, stellate hairs over smaller, sessile, stellate hairs. Scale bars = 200 µm. Images by K.A. Shepherd from G.J. Keighery & N. Gibson 2917 (A) and C.F. Wilkins & B. Vincent CW 2097 (B).



Figure 2. *Lasiopetalum caroliae*. A – Dr Carol Wilkins holding the species named in her honour; B – habit; C – dichasial inflorescences; D – flowers, showing red peduncle and pedicel, narrow, pink, petaloid calyx lobes with a deep red base, deep purple anthers, and dense, white, reflexed, stellate hairs along the length of the style. Vouchers: K.A. Shepherd & C.F. Wilkins KS 1618 (B); F. Hort & B. Hort 2678 (C, D). Photographs by K.A. Shepherd (A), C.F. Wilkins (B) and F. and J. Hort (C, D).

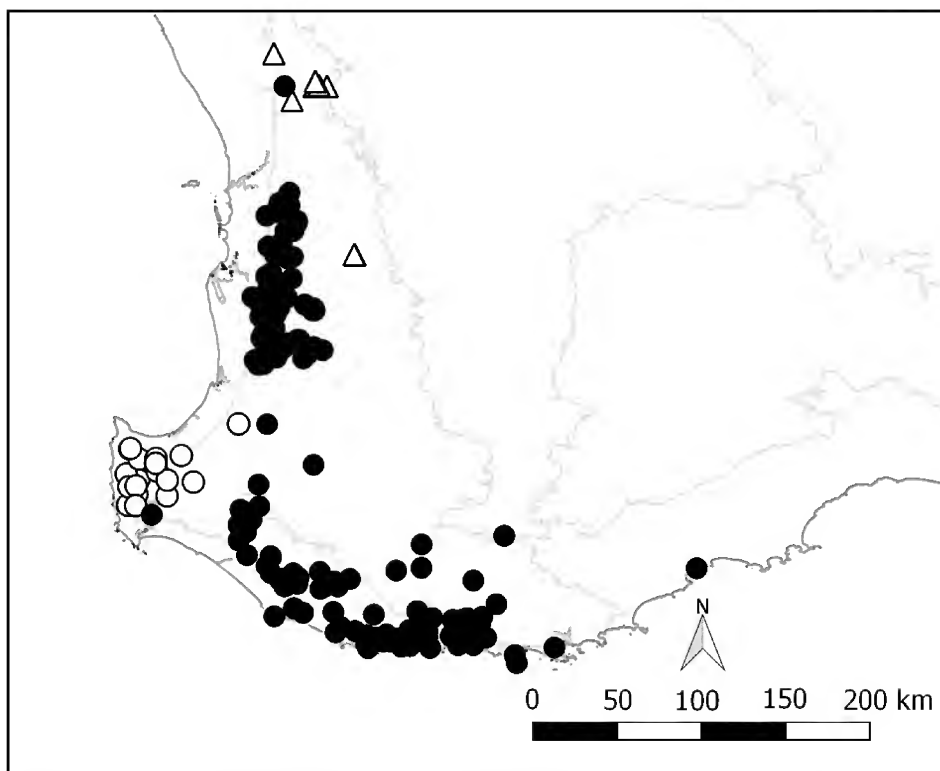


Figure 3. Distribution of *Lasiopetalum caroliae* ( $\Delta$ ), *L. floribundum* ( $\bullet$ ) and *L. occidentale* ( $\circ$ ) in Western Australia, with IBRA regions (Department of the Environment 2013) in pale grey.

**Affinities.** *Lasiopetalum caroliae* has leaves most similar in texture to *L. glabratum* Paust but they are not as coriaceous and the apex is rounded rather than acute. The scale-like, stellate hairs (Figure 1A) readily distinguish it from all other species within this group.

***Lasiopetalum floribundum*** Benth., *Fl. Austral.* 1: 265 (1863). *Type citation*: ‘W. Australia, Drummond, n. 28 and 156, Oldfield, Maxwell: Darling Range, Collie; between Perth and King George’s Sound, Harvey.’ *Type specimens*: Swan R[iver, Western Australia, 1842], *J. Drummond* 2: 28 (*lecto*, here designated: K 000686582! [two right hand fragments]; *isolecto*: BM 000031048! [right hand fragment ‘b’]; BM 000031049!; CGE 12991!; G 00358447 image!; G 00358448 image!; K 000749704! [left hand fragment ‘a’]; LD 1679775!; MEL 235665 image!; W 9005! [two left hand fragments]); Swan River, Western Australia, *J. Drummond* 156 (*syn*: K 000686591!; MEL 235654 image!); W. Aust., *Oldfield s.n.* (*syn*: K 000686589!; MEL 235663 image!); West. Australia, *Maxwell s.n.* (*syn*: MEL 52341!); Swan R[iver] Darling Range, *Collie s.n.* (*syn*: K 000686586! [right hand fragment]); ‘between Perth and K. G. Sound, W. Australia. April, July 1854’, *W.H. Harvey s.n.* (*syn*: K 000686584 image!; K 000686587!) = *L. glabratum* Paust.

*Corethrostylis parviflora* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 20(1): 174 (1847), non *Lasiopetalum parviflorum* Rudge (1811). *Type citation*: ‘In Nova Hollandia occidentali prope Gorge of Murray legit cl: Gilbert. coll. ejus n. 83.’ *Type specimen*: 200 m W of Pinjarra–Williams Road on East Boundary Road, south east of Dwellingup, Western Australia, 6 December 1993, *C.F. Wilkins & K.A. Shepherd* CW 546 (*neotype*, here designated: PERTH 07971303).

*Corethrostylis oppositifolia* F.Muell., *Fragm.* 2(11): 6 (1860). *Type*: 'In Nova Hollandia austro-occidentali. Maxw.' (possible *holo*: MEL 52341!), *non Lasiopetalum oppositifolium* F.Muell. (1860).

Erect *shrub*, 0.6–2(–3) m high, 0.8–1.8(–3) m wide. *Young stems* moderately densely to densely hairy, with pale brown, golden, ferruginous or rarely purple-red (towards apex), stellate hairs, mainly sessile or with a stalk to *c.* 0.15 mm long, with 3–8 arms, each to 1.1 mm long, over dense, pale tan, stellate hairs each with 8–10 arms, each to 0.2 mm long, glandular hairs absent; mature stems red-brown, glabrescent. *Petioles* (1.5–)2.5–15 mm long, indumentum as for young stems. *Mature leaf blades* soft, ovate to broadly ovate, scarcely discoloured, (4–)25–58 mm long, (3.1–)13–43 mm wide, base cordate, apex acute or rounded-acute; margin entire, irregular, sinuate, multilobed, scarcely recurved or flat; abaxial surface with dense, sessile, golden, pale or dark tan-centred, stellate hairs (darker on veins) with 6–10 arms, each to 0.6 mm long, glandular hairs absent; adaxial surface with occasional, to moderately dense, tan to pale tan (occasionally red on new growth), stellate hairs with 6–10 arms, each 0.4–0.6 mm long, glandular hairs absent. *Inflorescence* a loose dichasium or compound dichasium, 43–73(–130) mm long, with 10–23(–40) flowers; *peduncles* 19.6–38.1 mm long, with occasional to scattered, sessile, pale gold, or ferruginous, stellate hairs with *c.* 12 arms, each 0.3–7 mm long, over dense, sessile, white, stellate hairs with 8–10 rotate arms, each to 0.2 mm long, and scattered to moderately dense, red-tipped, glandular hairs to 1.3 mm long. *Pedicels* 2.6–5.8 mm long, indumentum as for peduncles. *Bract* linear or very narrowly ovate, 0.9–1.6(–2.7) mm long, 0.1–0.2(–0.4) mm wide. *Epicalyx* bract attachment (0.3–)1–3 mm below the calyx, dark red, very narrowly ovate to linear, 0.5–1.2 mm long, 0.1–0.15 mm wide; abaxial surface apex and margin with scattered, white, or ferruginous, stellate hairs with 6–8 arms, each to 0.2 mm long, and occasional glandular hairs to 0.2 mm long; adaxial surface glabrous, or with moderately dense, white or pale tan, stellate hairs with *c.* 6 arms, each to 0.15 mm long, glandular hairs absent. *Calyx* mainly pale pink, mauve or white, base dark red, 5.5–6.1 mm long with the tube 0.4–0.6 mm long; lobes narrowly ovate, 5.1–5.5 mm long, 0.7–1.1 mm wide; apex acute; outer surface with occasional to moderately dense, pale tan, stellate hairs with *c.* 8 arms, each to 0.8 mm long, over moderately dense to dense, white or pale tan, stellate hairs with 5–12 rotate arms, each to 0.15 mm long, glandular hairs absent; inner surface with scattered, white, simple or stellate hairs with 2–6 arms, each to 0.15 mm long. *Staminal filaments* 0.25–0.6 mm long, 0.15–0.2 mm wide. *Anthers* ovate, red-purple, 1.1–1.3(–1.6) mm long, 0.5–0.6 mm wide. *Ovary* 0.5–1 mm long, 0.5–1 mm wide, outer surface green with dense, white, stellate hairs to 0.15 mm long, rarely with occasional, red, glandular hairs to 0.2 mm long. *Style* 2.5–2.8 mm long. *Fruit* obovate, *c.* 3 mm long, *c.* 2.6 mm wide, with residual moderately dense, white, stellate hairs and scattered, glandular hairs. *Seed* ellipsoid, dull, black, 1.5–1.9 mm long, 0.9–1 mm wide, with scattered, white, stellate hairs; aril a yellow cap with two short arms, 0.7 mm long, *c.* 1.1 mm wide. (Figures 4, 5)

*Diagnostic features.* *Lasiopetalum floribundum* may be distinguished from other species in the genus that have reflexed, fan shaped, stellate hairs along the length of the style, by its compound dichasium inflorescences with  $\geq 10$  flowers, the narrow epicalyx bract, narrow calyx lobes  $< 1.1$  mm wide, the soft, scarcely discoloured, ovate leaves with brown, golden or ferruginous (rarely purple-red), stellate hairs and the presence of glands on the pedicels and peduncles but not on the outer surface of calyx.

*Selected specimens examined.* WESTERN AUSTRALIA: Samson Brook transect, Samson Block, 20 Apr. 2000, R.R. Archer RRA 105 (PERTH); Gleneagle Forest, Kinsella Rd, between Albany and Brookton Hwys, near Canning Rd, 21 Oct. 1981, M.G. Corrick 7852 (CANB, MEL); NW of Stirling dam in watercourse, 29 May 1996, R. Davis RD 955 (PERTH); towards Jarrahdale, 16 Sep. 1997, S. Donaldson & G. Flowers SD 1674 (PERTH); Ernest Forest Block W of Harvey, 10 May 1980, D. Halford 8055 (PERTH); Denmark shire, N of South Coast Hwy, FR 17925, 13 Nov. 1999, B.G. Hammersley 2363 (PERTH); Karri Valley between Bridgetown to Nannup, 19 Nov. 1987,



Figure 4. *Lasiopetalum floribundum* typical form. A – habit; B – flowering branchlets; C – soft, broadly ovate leaves with rounded-acute apices and compound dichasial inflorescences; D – peduncle and pedicels covered in stellate hairs and red-tipped, glandular hairs and flowers with pale pink, narrow, petaloid calyx lobes with red patch at base. Voucher: *K.A. Shepherd & S.R. Willis* KS 1655. Photographs by *K.A. Shepherd*.

*G.J. Keighery* 11,250 (AD, BRI, CANB, K, MEL, NSW, PERTH); Torbay Hill, West Cape Howe NP, W of Albany, 24 Nov. 1991, *G.J. Keighery* 12,513 (PERTH); Mt Barker to Denmark Rd, NNE of Denmark, 1 Nov. 1995, *T.R. Lally* 845 (BRI, CANB, HO, PERTH); 2 km W on Nelson Rd from the South Western Hwy, D'Entrecasteaux NP, 25 Oct. 2016, *K.A. Shepherd & C.F. Wilkins* KS 1641 (PERTH); 1.1 km W on the Harvey–Quindanning Rd from Honeymoon Rd, E of Harvey, 12 Nov. 2016, *K.A. Shepherd & S.R. Willis* KS 1655 (AD, CANB, MEL, NSW, PERTH); Chalk Forest Block, N of Collie, 9 Oct. 2002, *B.G. Ward & R.J. Cranfield* FC 370 (PERTH); Walpole–Nornalup NP, 27 Jan. 1993, *J.R. Wheeler* 3791 & *S.J. Patrick* (PERTH); power line track, E Boundary Rd W of Pinjarra–Williams Rd, 6 Dec. 1993, *C.F. Wilkins & K.A. Shepherd* CW 546 (PERTH); Harvey–Quindanning Rd, corner of Doodanally Rd, 6 Dec. 1993, *C.F. Wilkins & K.A. Shepherd* CW 552 (CANB, PERTH); near Serpentine Dam, SE of Jarrahdale, 30 Nov. 2004, *C.F. Wilkins & B. Vincent* CW 2097 (PERTH).

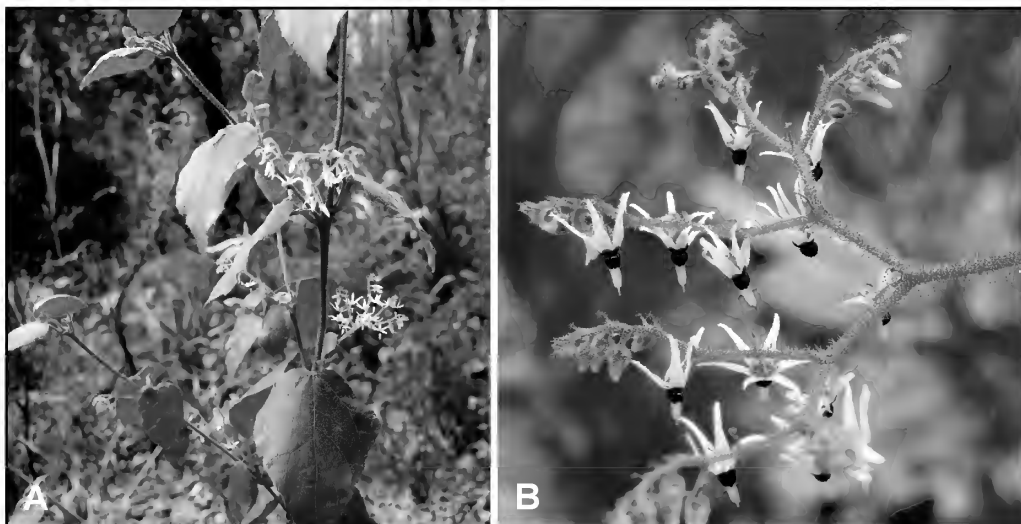


Figure 5. *Lasiopetalum floribundum* southern form. A – habit, showing large, ovate leaves with acute apices; B – compound dichasial inflorescence with large numbers of small, white flowers. Voucher: K.A. Shepherd & C.F. Wilkins KS 1641. Photographs by K.A. Shepherd.

**Phenology.** Flowering has been recorded from September to December. Fruiting material has been observed on specimens collected in December.

**Distribution and habitat.** *Lasiopetalum floribundum* is distributed from the Canning Dam near Perth to West Cape Howe, west of Albany, in the Swan Coastal Plain, Jarrah Forest, Warren and Esperance Plains bioregions (IBRA7; Department of the Environment 2013) (Figure 3). It is found in jarrah, marri, karri and tingle forest, in lateritic sandy clay or grey, loamy sand, often with granite boulders, mainly in river valleys near creek lines.

**Conservation status.** This species is reasonably widespread and not considered to be under threat at this time.

**Typification.** Bentham's (1863) description of *L. floribundum* is quite broad, encompassing the morphological variation evident across the six collections he cited in the protologue. Five of these (*Drummond* 28, *Drummond* 156, *Oldfield s.n.*, *Maxwell s.n.* and *Collie s.n.*) match our current understanding of *L. floribundum* (although the *Oldfield* collection represents a southern variant of the species; see *Notes* section below); however, Harvey's collection is referable to *L. glabratum*. It is therefore necessary to designate a lectotype to fix the application of the name *L. floribundum*.

In addition to specimens in his own herbarium (now at K), Bentham had access to a wide variety of material when compiling *Flora Australiensis*, including but not limited to specimens in Hooker's Herbarium (K), Lindley's herbarium (CGE), Mueller's herbarium (MEL), the Banksian herbarium and Robert Brown's herbarium (BM). Of the type material cited above, Bentham is thought to have seen the following sheets: K 000686582 (*Drummond* 2: 28, Herbarium Benthamianum), CGE 12991 (*Drummond* 2: 28), K 000686591 (*Drummond* 156, Herbarium Hookerianum), K 000686589 (*Oldfield s.n.*, Herbarium Hookerianum), MEL 23566 (*Oldfield s.n.*, annotated 'B' indicating Bentham viewed the material), MEL 52341 (*Maxwell s.n.*, annotated 'B'), K 000686584 and K 000686587 (*Harvey s.n.*, Herbarium Hookerianum), and K 000686586 (*Collie s.n.*, Herbarium Hookerianum).

While Bentham may have also viewed BM 000031048 and BM 000031049, there are no annotations on either sheet to confirm this.

Drummond's '28' gathering from his second series matches the protologue and constitutes the largest amount of type material located to date, with many of the duplicates being of reasonable quality. The two right hand fragments on K 000686582 are designated here as the lectotype. This material bears the label '28 *Corethrostylis* Swan River Drummond' written in Bentham's hand and is stamped with 'Herbarium Benthamianum 1854' and as such comprised part of his personal collection. Two other fragments on the left hand side of the sheet (K 000686583) do not represent type material: these fragments are from a different Drummond gathering (n. 20) and are referable to *L. glabratum*.

The two 'W. Aust.' *Oldfield s.n.* sheets (K 000686589; MEL 235663) are a match for the southern variant of *L. floribundum* (see *Notes* below).

*Corethrostylis parviflora* was considered a synonym of *L. floribundum* by Bentham (1863) based on Turczaninow's (1847) protologue ('from the character given'). This name was based on material collected by Gilbert (n. 83) 'In Nova Hollandia occidentali prope Gorge of Murray'; however, the relevant sheet at the National Herbarium of Ukraine (KW 001000138) does not include corresponding plant material. While a Gilbert label annotated with the number 83 and the name *Corethrostylis parviflora* is mounted on the lower right-hand side of this sheet there is no reference to the collecting locality of Murray River. Moreover, the four plant fragments on the sheet all correspond to type material of *C. microphylla* Turcz. (KW 001000139, left-hand label, *Drummond* 259), a species Bentham (1863) later synonymised under *L. cordifolium* Endl., and as such are in serious conflict with the protologue of *C. parviflora*.

Specimens in the Turczaninow herbarium (KW-TURCZ) were originally unmounted and often two or more specimens/fragments and their corresponding labels were placed in one folder or on one sheet. The type specimens of taxa described by Turczaninow were mounted in the 1970s exactly as they were arranged on sheets. No specimen corresponding to *C. parviflora* has been found after a thorough search at KW, and therefore it is likely to be lost (S. Mosyakin pers. comm.). As a consequence we consider that the Gilbert material used by Turczaninow is no longer extant (or, if extant it is lost or misplaced and cannot be associated with the original label with any degree of certainty). Moreover, no duplicates have been located to date. Turczaninow's description of *C. parviflora* is referable to *L. floribundum* (or possibly *L. occidentale* K.A. Sheph. & C.F. Wilkins but this species is known to occur south-west of the Murray River) and while *C. parviflora* is an earlier name, this epithet is already occupied in *Lasiopetalum* by *L. parviflorum* Rudge (1811), a species confined to the east coast of Australia. In the absence of original material, *sensu* Art. 9.3 of the *International Code of Nomenclature for algae, fungi, and plants* (ICN), we were unable to apply the name *C. parviflora* with certainty; consequently we have designated a neotype (ICN Art. 9.7) to fix the application of this name and ensure that it corresponds to the protologue.

*Corethrostylis oppositifolia* (Mueller 1860) is an earlier name for *L. floribundum* but the epithet is already occupied by *L. oppositifolium* F. Muell. (a distinct species from north of Geraldton), having been named by Mueller at the same time. MEL 52341, which is annotated by Mueller as 'West Australia Maxwell', is interpreted as a possible holotype for this name. Although Mueller did not annotate it with the species name, it is the only known matching specimen. This collection is also a syntype of *L. floribundum* Benth.

*Affinities.* *Lasiopetalum floribundum* remains quite variable across its range (see *Notes* section below), despite the exclusion of the Margaret River species recognised herein as *L. occidentale*. It can be distinguished from that species in having entire to irregular or occasionally multilobed leaves (*cf.* consistently distinctly trilobed), a longer inflorescence 42–73(–130) mm long (*cf.* 19–28(–41)) and 10–23(–40) flowers per inflorescence (*cf.* 5–7(–9)). Plants with lobed leaves are also readily distinguished from *L. pterocarpum* E.M.Benn. & K.A.Sheph. in having an ovoid rather than winged ovary and sparser hairs on the abaxial leaf surface. Further comparative notes are provided in the affinities section for *L. pterocarpum*.

*Lasiopetalum floribundum* has soft, pliable leaves similar to those of *L. rutilans* K.A.Sheph. & C.F.Wilkins and *L. mouleian* K.A.Sheph. & C.F.Wilkins but it is distinguished from these species in having narrower calyx lobes  $\leq 1.1$  mm wide (*cf.* 1.4–2.8), the base of the inner calyx being dark red (*cf.* dark red and green) and 10–23(–40) flowers per inflorescence (*cf.* 2–15).

*Notes.* Considerable morphological variation in the size, shape and possibly the indumentum of leaves as well as the number of flowers remains within *L. floribundum*. This variation is particularly evident when comparing the northern-most specimens from the Perth region (*c.* 32° S latitude) found in jarrah and marri forest to collections in the karri forest near Walpole and Denmark (34° to 35° S latitude). The northern form usually has mature leaves that are broadly ovate (Length:Width = 1:1) with more rounded-acute apex, and dichasial inflorescences to 75 mm long with 6–23 bright pink flowers (Figure 4). In contrast, plants from the southern Karri forest regions have ovate mature leaves (L:W = 3:2) with an acute apex and usually compound dichasial inflorescences to 90 mm long with 10–23(–40) white or pale pink flowers (Figure 5). While the two extremes appear distinct it is difficult to consistently distinguish the two forms across the range of the species. Most of the type material cited by Bentham (1863) in the protologue matches the northern form (as does the designated lectotype), although the two *Oldfield s.n.* syntypes (K 000686589; MEL 235663) are consistent with the southern form of the species. A detailed morphological and molecular analysis of *L. floribundum* across its entire range is required to assess the taxonomic status of the southern form and confirm if it should be recognised as a distinct taxon.

***Lasiopetalum glabratum*** Paust, *Nuytsia* 1: 359, Figures 8, 12 (1974). *Type*: Two miles north of turnoff to Mount Cooke on Albany Highway, Western Australia, 6 November 1971, S. Paust 1068 (*holo*: PERTH 01625527!).

Erect or spreading *subshrub* to *shrub* 0.25–0.4(–0.8) m high, 0.1–1 m wide. *Young stems* densely hairy to tomentose, with scattered, tan, stellate hairs, mainly sessile or with a stalk to *c.* 0.15 mm long, with 10–15 arms, each to 0.5 mm long, over dense, tan or dark red, stellate hairs, with 10–15 arms, each to 0.2 mm long, and scattered, red-tipped, glandular hairs to 0.5 mm long; mature stems red-brown, glabrescent. *Petioles* 1.5–6 mm long, indumentum as for young stems but without glands. *Mature leaf blades* coriaceous, ovate to broadly ovate, scarcely discoloured, (3–)14–40 mm long, (2.8–)13.3–22 mm wide, base cordate, apex acute or rounded-acute, margin irregular, entire or occasionally trilobed, flat or scarcely recurved; abaxial surface glabrous or with occasional or scattered, sessile, beige or white (some pale tan-centred), stellate hairs with 6–12 arms, each to 0.3 mm long on veins, glandular hairs mainly absent or scattered on veins or margin, to 0.5 mm long; adaxial surface glabrous or with occasional, beige or white with some pale tan-centred, stellate hairs with 10–12 arms, each to 0.6 mm long on veins. *Inflorescence* a loose monochasium or dichasium, 36–72(–129) mm long, with 3–6(–9) flowers; *peduncles* 19.1–42 mm long, with moderately dense to dense, sessile, pale tan, stellate hairs with 10–12 arms, each to 0.3 mm long, beneath dense, red-tipped, glandular hairs 0.2–0.5 mm

long. *Pedicels* 2.3–4.8 mm long, indumentum as for peduncles. *Bract* linear, very narrowly ovate to narrowly ovate, 0.8–4.3 mm long, 0.2–0.4(–0.8) mm wide. *Epicalyx bract* attachment 0.1–0.7 mm below the calyx, green, narrowly ovate to linear, 1–2.5 mm long, 0.15–0.3 mm wide; abaxial surface and margin with scattered to moderately dense, pale tan, stellate hairs, with 8–10 arms, each to 0.3 mm long, and glandular hairs to 0.25 mm long; adaxial surface glabrous, or with scattered, white, stellate hairs with *c.* 6 arms, each to 0.15 mm long, glandular hairs absent. *Calyx* pale mauve-pink, base dark red, 6.2–7.1 mm long with the tube 0.4–0.8 mm long; lobes narrowly elliptic, 5.6–6.3 mm long, 1.3–3 mm wide, apex acute; outer surface with moderately dense, white or pale tan, stellate hairs with 6–10 arms, each to 0.15 mm long (occasionally to 0.4 mm long), and scattered, red-tipped, glandular hairs to 0.4 mm long; inner surface with scattered, white, simple or stellate hairs with 2–6 arms, each to 0.15 mm long. *Staminal filaments* 0.5–0.8 mm long, 0.15–0.2 mm wide. *Anthers* ovate, red-purple, 1.5–2 mm long, 0.7–0.8 mm wide. *Ovary* 0.5–1 mm long, 0.5–1 mm wide; outer surface green with dense, white, stellate hairs to 0.15 mm long, rarely with occasional, red, glandular hairs to 0.2 mm long. *Style* 2.4–3.7 mm long. *Fruit and seed* not observed. (Figure 6)

*Diagnostic features.* *Lasiopetalum glabratum* is distinctive within the group of species allied to *L. floribundum* in having ovate, coriaceous leaves with an acute apex, that are mainly glabrous or with only a few stellate hairs present on the veins.

*Other specimens examined.* WESTERNAUSTRALIA: Russell Forest Block, 14 Mar. 2000, *C. Adonis* CA 16 (PERTH); NW of Mt Yetar, 5 Nov. 1996, *M.G. Allen* 163 (PERTH); W of Poison Gully off Brookton Hwy, 6 Oct. 2003, *R.J. Cranfield* FC 525 (PERTH); SSE of Mt Dale, 16 July 1997, *R. Davis* 3848 (PERTH); NW of North Bannister, 24 Oct. 1991, *W. Greuter* 23210 (PERTH); SSW of Mt Vincent, 5 Aug. 1997, *A. Gundry* 27 (PERTH); W of North Bannister, 23 Nov. 2003, *M. Hislop* 3112 (PERTH); WSW of Mt Solus, 31 July 1997, *M.J. Kealley* 645 (PERTH); ESE of Mt Cooke, 9 Aug. 1997, *M.J. Kealley* 1174 (PERTH); near Mt Cooke, 12 May 1993, *K.L. Lemson* KLL 307 (PERTH); Albany Hwy, S of Armadale, 8 May 1983, *T.D. Macfarlane* 1147 (PERTH); Sawyers Valley, 1 Dec. 1987, *M. Mandra s.n.* (PERTH); W of Metro Rd, S of Brookton Hwy, 9 Jan. 1999, *L.W. Sage, F. Hort & J. Hort* LWS 1469 (PERTH); W of Sullivan's Rock, 26 Oct. 1996, *K.A. Shepherd & J.A. Wege* KS 258 (PERTH); Sullivan's Rock above the picnic area, 9.6 km SSW on the Albany Hwy from Jarrahdale Rd, 27 Oct. 2016, *K.A. Shepherd & C.F. Wilkins* KS 1653 (PERTH); Geddes Block, 8 Feb. 1999, *R. Smith* RSS 700 (PERTH); S of Sullivan's Rock, 17 Nov. 1993, *C.F. Wilkins* 355 (PERTH); Saint Ronan's NR, 13 Oct. 2003, *C.F. Wilkins & J.A. Wege* CW 1788 (PERTH).

*Phenology.* Flowering usually from August to December, although flowers were observed on a specimen collected in early January from a winter-wet area (*L.W. Sage et al.* LWS 1469).

*Distribution and habitat.* *Lasiopetalum glabratum* is found east of Perth in the Swan Coastal Plain, Jarrah Forest and Avon Wheatbelt bioregions (IBRA7; Department of the Environment 2013) (Figure 7). This species grows in jarrah forest with *Allocasuarina fraseriana* and *Xanthorrhoea preissii* or open wandoo woodland in brown, lateritic loam over granite.

*Conservation status.* While this species does not have a wide distribution it is generally locally abundant and is not considered to be under threat at this time.

*Affinities.* Refer to comparative notes under the affinities section for *L. caroliae*.



Figure 6. *Lasiopetalum glabratum*. A – flowering branch, showing coriaceous leaves that are glabrous or have scattered stellate hairs on the veins; B – inflorescence, showing moderately dense, stellate hairs on the pedicels, and very short epicalyx bract (white arrow) subtending the petaloid calyx; C – flowers, each with narrowly ovate, pale pink, petaloid calyx lobes with red patch at base. Voucher: K.A. Shepherd & C.F. Wilkins KS 1653. Photographs by K.A. Shepherd.

***Lasiopetalum moulleian* K.A. Sheph. & C.F. Wilkins, *sp. nov.***

*Type:* north-east of Kwolyin, Western Australia [precise locality withheld for conservation reasons], 28 September 2016, K.A. Shepherd & C.F. Wilkins KS 1621 (*holo:* PERTH 08858160; *iso:* AD, BRI, CANB, K, MEL, NSW, PERTH 08844216).

*Lasiopetalum* sp. Mount Caroline (S.D. Hopper SDH 6381), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 30 August 2016].

Erect or spreading *shrub* 0.4–1.8 m high, c. 1.5 m wide. *Young stems* moderately densely to densely hairy, with red, stellate hairs, mainly sessile or with a stalk to 0.15 mm long, and 7–10 arms, each to 1.8 mm long, over moderately dense white, stellate hairs with 6–8 arms, each to 0.2 mm long, glandular hairs absent; mature stems red-brown, glabrescent. *Petioles* (0.6–)2.3–9.1 mm long, indumentum

as for young stems. *Mature leaf blades* soft, ovate, scarcely discolorous, (2–) 5.6–22.7 mm long, (1.6–)6–16 mm wide, base cordate, apex acute; margin entire to sinuate, flat or scarcely recurved; abaxial surface with scattered yellowish cream or tan, stellate hairs with 6–10 arms, each to 0.8 mm long, over moderately dense white, stellate hairs with 8–10 arms, each to 0.15–3 mm long; adaxial surface with scattered to moderately dense, cream-brown, stellate hairs with 8–10 arms, each to 0.8 mm long, glandular hairs absent. *Inflorescence* a loose monochasium or rarely a dichasium 17–48 mm long, with 2–6 flowers per inflorescence; *peduncles* 14.3–34.1 mm long, with moderately dense to dense stellate hairs with c. 12 rotate arms, each to 0.15 mm long and scattered to moderately dense, red-tipped, glandular hairs to 1.5 mm long and with or without scattered bright red, stellate hairs with 4–8 arms, each to 1.1 mm long. *Pedicels* 4.3–7.3 mm long, indumentum as for peduncles. *Bract* very narrowly ovate or very narrowly elliptic, 1.5–3.5 mm long, 0.15–0.5 mm wide. *Epicalyx bract* green, attachment 0.1–0.9 mm below the calyx, very narrowly elliptic, 1–2.7 mm long, 0.15–0.5 mm wide; abaxial surface with scattered tan, stellate hairs with c. 6 arms, each to 0.5 mm long; adaxial surface with a white, apical stellate hair with c. 6–10 arms, each to 0.8 mm long and with or without occasional to scattered stellate hairs with c. 6 rotate arms, each to 0.2 mm long, glandular hairs absent. *Calyx* pale mauve-pink, base dark red with green at the lobe junctions, 5.5–6.2 mm long, with a tube 0.5–0.9 mm long; lobes narrowly ovate, 4.8–5.7 mm long, 1.4–1.7 mm wide, apex acute; outer surface with tan stellate hairs with c. 6 arms, each to 0.7 mm long, over moderately dense white, stellate hairs throughout, each with c. 6 arms, to 0.15 mm long and scattered glandular hairs to 1.3 mm long; inner surface with scattered white, stellate hairs with 1–6 arms, each 0.15 mm long. *Staminal filaments* 0.5–0.7 mm long, 0.15–0.2 mm wide. *Anthers* ovate, red-purple, 1.5–1.7 mm long, 0.6–0.8 mm wide. *Ovary* 0.8–1 mm long, 0.8–1 mm wide; outer surface with dense, white, stellate hairs to 0.3 mm long, rarely with glandular hairs to 0.2 mm long. *Style* 2.5–2.8 mm long. *Fruit* an ellipsoid to scarcely obovoid capsule, 3–4 mm long, 3–4 mm wide, with residual, moderately dense, small, white, stellate hairs. *Seed* ellipsoid, dull, blackish brown with few to moderately dense, stellate hairs, 2–2.3 mm long, 1–1.3 mm wide, aril a cream-brown cap with 2–5 arms, as long as, or longer than seed, 1.6–2.3 mm long, 1–1.3 mm wide. (Figure 8)

*Diagnostic features.* *Lasiopetalum mouleean* is distinguished from allied species by the presence of a moderately dense layer of small, white, stellate hairs beneath the large yellowish cream or tan, stellate hairs on the lower surface of the leaves; an inflorescence with 2–6 flowers; the outer surface of the calyx covered in small, white, stellate hairs throughout (beneath the glandular and larger stellate hairs); stellate hairs on the inner surface of the calyx; and a large seed aril with 2–5 arms, which is as long as, or longer than seed.

*Specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 30 Sep. 1988, J.J. Alford 1106 (PERTH); 1 Sep. 2016, N. Moore, J. Borger & J. Lindley JBKok-10 (NSW, PERTH); 4 July 1988, S.D. Hopper SDH 6381 (PERTH); 12 Nov. 1996, L. Sweedman 4352 (PERTH); 2 June 1975, E. Wittwer 1540 (PERTH).

*Phenology.* Flowering recorded from June to November with seeds collected in December (A. Crawford pers. comm.).

*Distribution and habitat.* *Lasiopetalum mouleean* is an extremely restricted species currently known from only two localities in the Kellerberrin–Kwolyin area of the Avon Wheatbelt bioregion (IBRA7; Department of the Environment 2013) (Figure 7). This species is found growing in loam over massive granite, or at the base of granite rock, under *Eucalyptus caesia* with sedges and grasses or associated with *Tetratheca deltoidea* thickets.

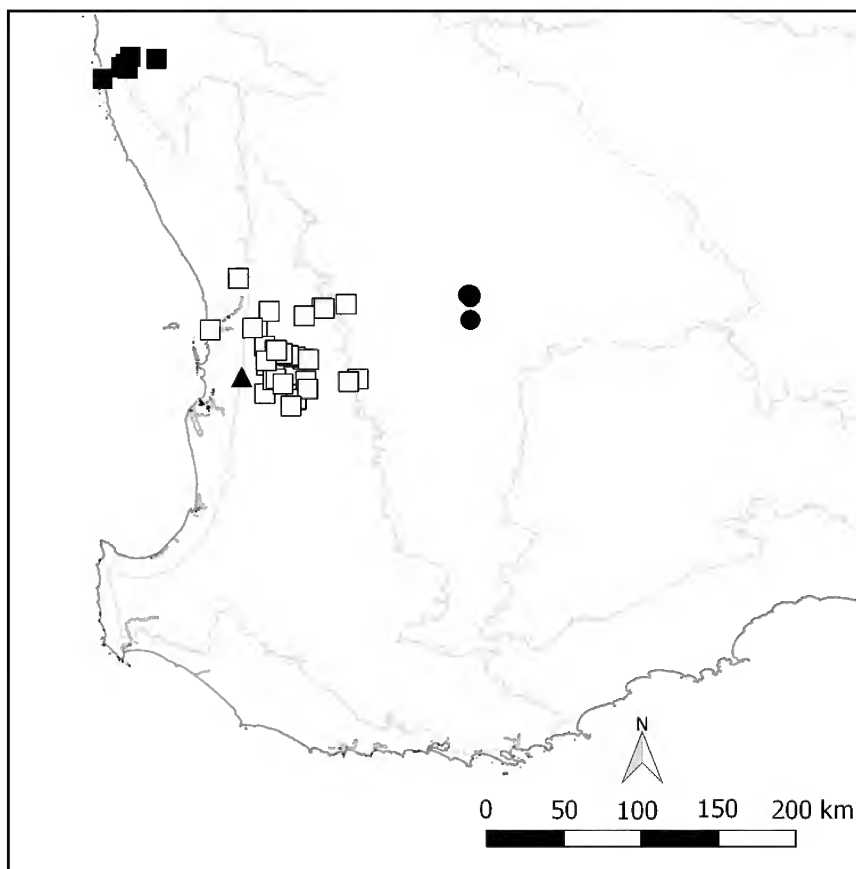


Figure 7. Distribution of *Lasiopetalum glabratum* (□), *L. pterocarpum* (▲), *L. rutilans* (■) and *L. moullean* (●) in Western Australia, with IBRA regions (Department of the Environment 2013) in pale grey.

**Conservation status.** *Lasiopetalum moullean* is currently listed by Smith (2017) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *L. sp. Mount Caroline* (S.D. Hopper SDH 6381). This species was previously only known from Mt Caroline and was represented by only four specimens at the Western Australian Herbarium collected between 1975 and 1996. Targeted survey efforts in recent years had failed to relocate any plants at Mt Caroline, an area that is currently heavily grazed by kangaroos and native wallabies (Natasha Moore pers. comm.); however, in the spring of 2016 Natasha Moore and Jazmin Lindley (Department of Biodiversity, Conservation and Attractions, formerly Parks and Wildlife) along with Jenny Borger discovered a single plant south-east of Mt Caroline (Figure 8A). This team later discovered another small plant at Mt Caroline. As these remain the only two known extant plants of this species it is probable that this species will in the near future be recognised as Threatened.

**Etymology.** The granite hills and surrounds near Mt Caroline were collectively referred to as the ‘Moullean’ (alternate spelling ‘Mullean’) by the local Noongar people (Drummond 1847; Wilson 1981; Harben *et al.* 2008). The specific epithet recognises the restricted distribution of this species in this region, and is used here as a noun in apposition.



Figure 8. *Lasiopetalum mouleean*. A – habit, with Natasha Moore (left) and Jazmin Lindley (right) who, with Jenny Borger, rediscovered the only two extant plants currently known of this species; B – leaves, showing the bright red colour of the stellate hairs on new growth; C – branchlet showing ovate leaves and monochasial inflorescences; D – flowers, highlighting the pale pink calyces with a red base with green at the junction of each lobe; E – outer surface of calyx and red pedicel with scattered, bright red, stellate hairs and glands over dense, small, white, stellate hairs. Voucher: K.A. Shepherd & C.F. Wilkins KS 1618. Photographs by K.A. Shepherd (A–C, E) and A. Crawford (D).

**Affinities.** *Lasiopetalum mouleean* is similar to *L. rutilans* in having bright red, stellate hairs evident on new growth of the stem, outer surface of calyx, pedicels and peduncle. It is readily distinguished from this species by the indumentum on the abaxial surface of the leaf, which has a moderately dense layer of small, white, stellate hairs beneath the large, yellowish cream or tan, stellate hairs (*cf.* small hairs absent beneath the larger stellate hairs), calyx lobes 1.4–1.7 mm wide (*cf.* (1.7–)2–2.8 mm wide) with small, white, stellate hairs all over the outer surface (*cf.* small stellate hairs at the base of the calyx or lobe margins only), stellate hairs on the inner surface of the calyx (*cf.* glabrous), and a distinct seed aril 1.6–2.3 mm long, with 2–5 arms. The arils in all other species of this group have only two arms and the total length of the aril ranges from 0.7–1.5 mm.

Also refer to the comparative notes under the affinities section for *L. floribundum*.

***Lasiopetalum occidentale* K.A. Sheph. & C.F. Wilkins, *sp. nov.***

*Type:* 800 m south of Gale Road on Carbunup Road South, south of Dunsborough, Western Australia, 12 November 2016, *K.A. Shepherd & S.R. Willis* KS 1654 (*holo:* PERTH 08858225; *iso:* AD, BM, BRI, CANB, DNA, HO, K, MEL, NSW, PERTH 08844208).

Erect, open *shrub* 0.3–3 m high, *c.* 1.8 m wide. *Young stems* densely hairy, with scattered, pale tan or tan, stellate hairs, mainly sessile or with a stalk to *c.* 0.15 mm long, with 3–10 arms, each to 1.3 mm long, over moderately dense, pale tan or beige, stellate hairs with 8–10 arms, each to 0.3 mm long, and with or without scattered, globular glands to 0.1 mm long; mature stems red-brown, glabrescent. *Petioles* (1.1–)2.2–8.3 mm long, indumentum as for young stems. *Mature leaf blades* soft, trilobed-ovate, scarcely discoloured (2.5–)6–27.3 mm long, (1.9–)3.8–27.3 mm wide, base scarcely cordate or rounded, apex acute; margins distinctly trilobed, flat or scarcely recurved; abaxial surface with moderately dense, tan or pale tan, stellate hairs with 8–12 arms, each to 0.8 mm long, glandular hairs absent; adaxial surface with scattered to moderately dense, cream, stellate hairs with *c.* 10 arms, each to 0.3 mm long and occasionally to 0.8 mm long. *Inflorescence* a loose dichasium, 19–28(–41) mm long, with 5–7(–9) flowers; *peduncles* 5–12.5 mm long, with scattered, pale tan, stellate hairs with 6–12 arms, each to 1.1 mm long, over moderately dense, pale tan, stellate hairs with 6 multiangulate or rotate arms, each to 0.15 mm long, and moderately dense red-tipped glandular hairs to 0.2–1.3 mm long. *Pedicels* 2.7–7.7 mm long, indumentum as for peduncles. *Bract* linear to very narrowly ovate, 0.5–2.3(–3) mm long, 0.15–0.3(–0.4) mm wide. *Epicalyx bract* attachment *c.* 1 mm below the calyx, linear to very narrowly ovate, dark red, 0.5–1.5 mm long, 0.15–0.2 mm wide; abaxial surface, margin and apex with scattered, white, stellate hairs with 10–13 arms, each to 0.6 mm long and with or without scattered, white, stellate hairs with *c.* 10 arms, each to 0.15 mm long below, and with or without occasional glandular hairs to 0.25 mm long; adaxial surface glabrous, or with scattered, white, stellate hairs with *c.* 6 arms, each to 0.2 mm long. *Calyx* mauve-pink, base dark red, 5.1–6.1 mm long, with a tube 0.4–0.6 mm long; lobes narrowly ovate, 4.5–5.7 mm long, 0.9–1.1 mm wide, apex acute; abaxial surface with occasional, cream, stellate hairs with *c.* 8 arms, each to 0.8 mm long, over dense, white, stellate hairs with 6–12 rotate arms each to 0.15 mm long, and with or without occasional glands to 0.15 mm long; adaxial surface with scattered, white, simple or stellate hairs with 1–6 arms, each to 0.15 mm long. *Staminal filaments* 0.5–0.6 mm long, 0.15–0.2 mm wide. *Anthers* ovate, red-purple, 1.1–1.3 mm long, 0.5–0.6 mm wide. *Ovary* 0.7–0.9 mm long, 0.7–0.9 mm wide; outer surface green with dense, white, stellate hairs to 0.15 mm long, and occasional, red, glandular hairs to 0.2 mm long. *Style* 2.2–2.8 mm long. *Fruit* a scarcely obovoid capsule, 3.2–3.5 mm long, 2.4–3.5 mm wide, with dense, small, white, stellate hairs. *Seed* ellipsoid, dull, blackish brown with dense, stellate hairs, seed *c.* 1.8 mm long, *c.* 1.1 mm wide; aril a white cap with two short arms, *c.* 0.7 mm long, *c.* 0.7 mm wide. (Figure 9)

*Diagnostic features.* *Lasiopetalum occidentale* is readily distinguished from morphologically allied species that have narrow calyx lobes and pliable leaves by the following combination of characters: mature leaves consistently and distinctly trilobed; inflorescences short (19–28(–41) mm), each with only 5–7 flowers.

*Selected specimens examined.* WESTERN AUSTRALIA: McCorkhill Forest Block, W of Nannup, month unknown 1986, *A.R. Annels* MJP 1832 (PERTH); E of Bussell Hwy, Warren Botanical district, 25 Sep. 1992, *A. Annels* 2426 (PERTH); S of Witchcliffe, 13 Oct. 1992, *A.R. Annels* ARA 2683 (PERTH); Tame Rd, near Molloy Rd, N of Augusta, 8 Jan. 1996, *E. Bennett & C. Godden* SC 155.3 (PERTH); near Nannup, Dec. 1930, *W.E. Blackall s.n.* (PERTH 04158288); S of intersection of Gale and Gibb Rds, SW of Busselton, 11 Dec. 1996, *N. Casson & C. McChesney* SC 66.1 (PERTH); Yelverton State



Figure 9. *Lasiopetalum occidentale*. A – habitat; B – habit; C – branchlet showing trilobed leaves and dichasial inflorescences with few flowers; D – peduncle and pedicels covered in stellate hairs and red-tipped glandular hairs 0.2–1.3 mm long; E – pale pink flowers with a red patch at the base of each calyx lobe. Voucher. K.A. Shepherd & S.R. Willis KS 1654. Photographs by K.A. Shepherd.

Forest, Cowaramup, 26 Nov. 2005, S.A. Fisher BNC 739 (PERTH); Sabina River crossing, Whicher Range, 17 Oct. 1973, A.S. George 11746 (PERTH); Big Brook, between Cowaramup and Margaret River, 7 Dec. 1974, T.A. Halliday 234 (PERTH); Treeton Forest Block, Margaret River shire, 7 Dec. 2005, G.J. & B.J. Keighery 856 (MEL, PERTH); Forest Grove Block, Margaret River to Augusta, 27 Dec. 1990, G.J. Keighery 12062 (CANB, PERTH); near Donnybrook, Aug. 1913, M. Koch 2123 (PERTH); Vasse–Karridale, Oct. 1898, A. Lea s.n. (PERTH 04158032); Mowen, 10 Oct. 1986, G.S. McCutcheon GSM 1433 (PERTH); near cnr Stuart and Jacka Rds, E of Margaret River, 16 Oct. 2007, M. Morley 417 (AD, MEL, NSW, PERTH); Nillup, SE of Margaret River, 14 Jan. 1945, R.D. Royce R15 (PERTH); Yelverton Forest Block, SW of Busselton, 16 Sep. 1996, D. Papenfus & S. Wood DP 545 (PERTH); Witchcliffe, 28 Oct. 2000, J. Scott 280 (PERTH); Jacka Rd, 1 km S of Stuart Rd, S of Busselton, 24 Oct. 2016, K.A. Shepherd & C.F. Wilkins KS 1634 (AD, BRI, CANB, DNA, HO, K, MEL, NSW, PERTH); Adelaide Block, Wapet Rd, Margaret River, 19 Jan. 1990, G. Wardell-Johnson 1049 (PERTH); Forest Grove NP, Margaret River, 12 Nov. 2002, A. Webb AW 2203 (PERTH).

*Phenology.* Flowering from August to February. Fruiting material has been observed on specimens collected in December.

*Distribution and habitat.* *Lasiopetalum occidentale* is distributed from Donnybrook, west to Busselton and Margaret River areas, south to Forest Grove near Witchcliffe and east to Nannup (Figure 3) in the Jarrah Forest and Warren bioregions (IBRA7; Department of the Environment 2013). This species grows in coarse, sandy clay or gravelly loam, sometimes near creek lines or wetlands in alluvial loam, in open marri, jarrah or karri forest or low woodlands often with *Agonis flexuosa*, *Taxandria parviceps*, *Trymalium odoratissimum* and mixed shrubland.

*Conservation status.* This species is not considered to be under threat at this time.

*Etymology.* From the Latin *occidentalis* (west or western), as this species comprises the westernmost populations that were previously included under *L. floribundum*.

*Affinities.* Mature leaves of *L. occidentale* are distinctly trilobed (juvenile leaves may be multilobed); in comparison the typical leaves of *L. floribundum* are always ovate with entire or multilobed margins. *Lasiopetalum occidentale* also has shorter inflorescences 19–28(–41) mm long (cf. 42–73(–130)) and 5–7(–9) flowers per inflorescence (cf. 10–23(–40)) than *L. floribundum*.

***Lasiopetalum pterocarpum*** E.M.Benn. & K.A.Sheph., *Nuytsia* 16(1): 177–179 (2006). *Type*: [Serpentine National Park,] Western Australia [precise locality withheld for conservation reasons], 26 October 1995, K. A. Shepherd & J.A. Wege KS 360 (*holo*: PERTH 07319193).

*Lasiopetalum* sp. Serpentine (S. Paust 1103 A), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au> [accessed 15 September 2016].

Erect *shrub*, 0.2–1.5 m high, 0.2–0.5 m wide. *Young stems* densely hairy to tomentose, with scattered to dense, ferruginous, stellate hairs with stalks to 0.8 mm long and 8–10 arms, each to 0.8 mm long, over dense, sessile, white, or white and ferruginous-centred, stellate hairs with 8–10 arms, each to 0.3 mm long, glandular hairs absent; mature stems reddish brown or brown, glabrescent. *Petioles* 4–14 mm long, indumentum as for young stems. *Mature leaf blades* soft, ovate, strongly discolorous, 25–80 mm long, 12–50 mm wide, base cordate, apex acute to obtuse; margin distinctly multilobed, flat or slightly incurved; abaxial surface with a tomentum of scattered, ferruginous, stellate hairs with 4–8 arms, each to 0.4 mm long, over white, stellate hairs with c. 12 arms sometimes rotate, each to

0.15 mm long, more dense on midrib; adaxial surface with scattered to moderately dense, white with tan-centred, stellate hairs with 8–10 arms, each to 0.6 mm long, glabrescent. *Inflorescence* a loose dichasium, 32–62 mm long, with 5–8(–11) flowers, occasionally a simple dichasium with 2 or 3 flowers; *peduncles* 9–55 mm long with scattered, ferruginous or white, stellate hairs with 6 or 7 arms, each to 0.7 mm long, over dense, sessile, white, stellate hairs with 6–10 arms, each to 0.2 mm long, becoming glabrous towards the base; glands absent. *Pedicels* 2.2–4 mm long, indumentum as for peduncles. *Bract* oblong, 0.8–3.8 mm long, 0.2–0.4 mm wide. *Epicalyx* bract attachment 0.5–0.7 mm from base of calyx, filiform, 0.7–3.5 mm long, 0.2–0.5 mm wide, with scattered, ferruginous or white, stalked, stellate hairs with c. 8 arms, each to 0.8 mm long, over dense, smaller, white, stellate hairs, with c. 10 arms, each to 0.2 mm long. *Calyx* pink, base dark red to purple, 6.2–8.7 mm long, with a tube 0.2–0.7 mm long; lobes narrowly elliptic, 5.7–8 mm long, 1–2.3 mm wide, apex acute; outer surface with scattered, ferruginous or white, stalked, stellate hairs with c. 12 arms, each to 0.6 mm long, over dense, stellate hairs with c. 12 arms, each to 0.15 mm long, denser towards the calyx base; inner surface with scattered, white, stellate, hairs with 1–6 arms, each to 0.15 mm long. *Staminal filaments* 0.75–1 mm long, 0.15–2 mm wide. *Anthers* elliptic, dark red, 1.4–1.8 mm long, 0.6–0.7 mm wide. *Ovary* 0.7–1 mm long, c. 0.9 mm wide; outer surface tomentose with white, stellate hairs and scattered, glandular hairs. *Style* 3–3.7 mm long. *Fruit* an ellipsoid capsule, 5.1–6 mm long, 8.4–10 mm wide (including wings), distinctly 6(–12) winged between the dehiscence lines, each wing c. 3.6 mm wide, outer surface with dense, stellate and glandular hairs. *Seed* ellipsoid, dull black, 2.8–3.4 mm long, 1.4–1.5 mm wide, with scattered, stellate hairs; aril a yellow cap with two arms, 1.4–1.5 mm long, 1.5 mm wide. (Figure 10)

*Diagnostic features.* The distinctly winged fruit of *L. pterocarpum* is unique within the genus (Figure 10E, F).

*Specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 7 Sep. 1999, *V. English* 1200 (PERTH); 24 Sep. 1999, *V. English & R.M. Evans s.n.* (PERTH 05414172); 22 Oct. 1899, *R. Helms s.n.* (BRI, NSW); 8 Dec. 1996, *A. Markey* 1021 (PERTH); 5 Aug. 1972, *S. Paust* 1103 A (BRI, PERTH); 30 July 1997, *J.L. Robson s.n.* (PERTH); 26 Sep. 2004, *C.F. & J. Wilkins* 2108 (PERTH); 12 May 2006, *C.F. Wilkins* 2157 (CANB, MEL, NSW, PERTH).

*Phenology.* Flowering from August to December. Fruiting November and December.

*Distribution and habitat.* *Lasiopetalum pterocarpum* is a rare species restricted to a single population c. 48 km south of Perth in the Jarrah Forest bioregion (IBRA7; Department of the Environment 2013) (Figure 7). This species is found growing in dark brown or red-brown loam or clayey sand over granite, near creek lines and on sloping banks in *Eucalyptus rudis* and *Corymbia calophylla* woodland over dense thickets of *Trymalium odoratissimum*.

*Conservation status.* This species is listed as Threatened (Critically Endangered) in Western Australia (Smith 2017). In 2009, a survey by Wilkins *et al.* confirmed that *L. pterocarpum* appeared to be confined to a single extant population, which at the time comprised c. 600 immature plants.

*Affinity.* This species is morphologically similar to *L. floribundum* with which it shares broadly ovate leaves, a loose dichasial inflorescence, and pale pink or white flowers with the calyx lobes divided almost to the base. While *L. floribundum* possesses entire to slightly irregularly lobed leaves bearing scattered stellate hairs, *L. pterocarpum* has leaves that are distinctly multilobed and strongly discoloured due to a tomentose stellate-hairy indumentum on the abaxial surface. The peduncle of *L. pterocarpum* is covered in stellate hairs only, while in *L. floribundum* both stellate and glandular hairs are present.

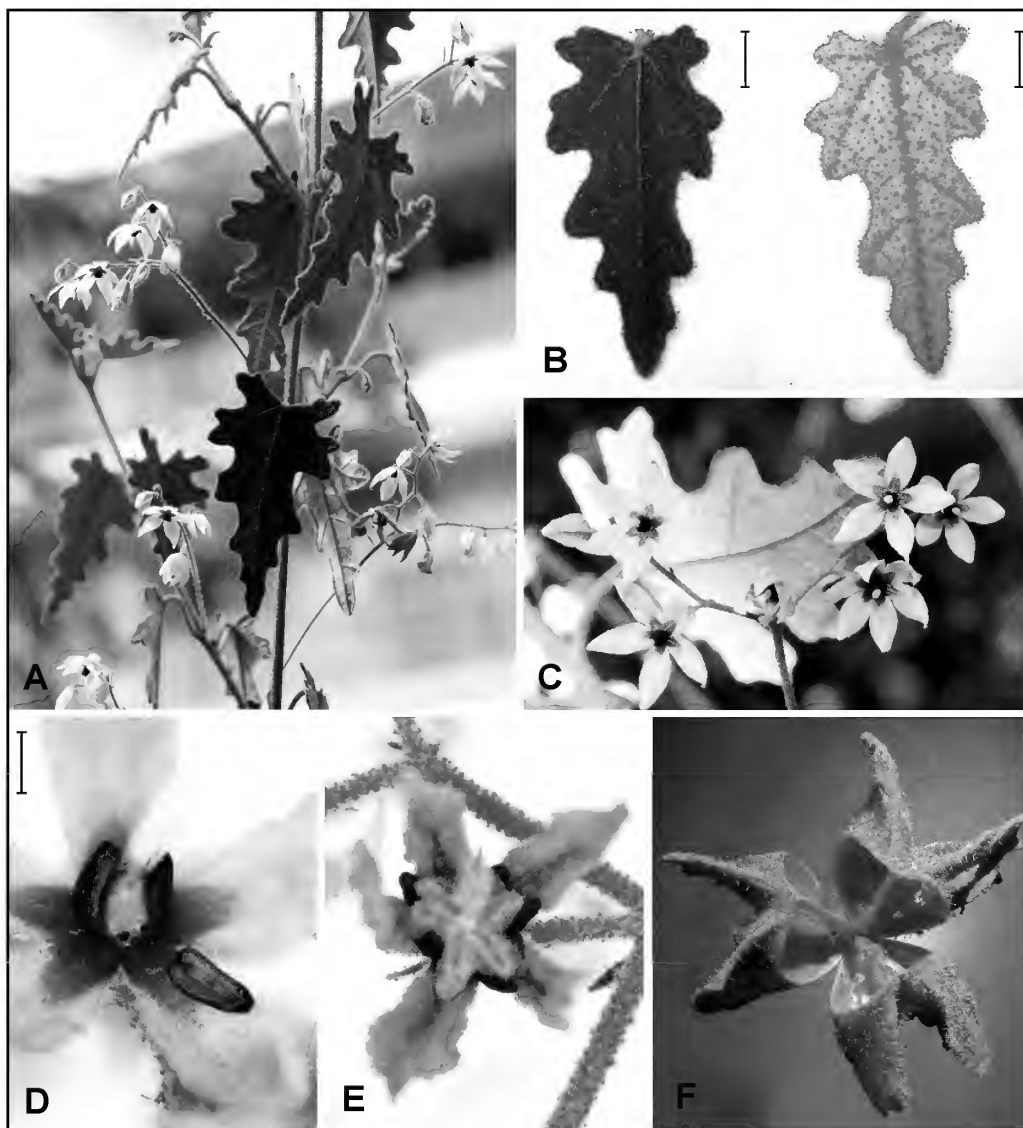


Figure 10. *Lasiopetalum pterocarpum*. A – habit; B – distinctly discoloured leaves with multilobed margins, adaxial surface (left) with scattered to moderately dense, white and tan-centred, stellate hairs, and abaxial surface (right) with scattered, ferruginous, stellate hairs over a tomentum of white, stellate hairs; C – a loose, dichasial inflorescence of pale pink flowers, showing elliptic calyx lobes with a red patch at the base; D – flower with an anther pulled away to show the pale green ovary covered in white, stellate hairs; E – immature green fruit developing six distinctive wings; F – 3-locular fruit with wings, showing scattered, stalked, clavate, glandular hairs as well as stellate hairs on the outer surface. Scale bars = 10 mm (B); 1.5 mm (D). Voucher: plant grown in cultivation in the grounds of the Department of Biodiversity, Conservation and Attractions' Keiran McNamara Conservation Science Centre, Kensington. Images by K.A. Shepherd.

*Lasiopetalum pterocarpum* also has larger flowers and seeds than *L. floribundum* (see Figure 4D in Shepherd *et al.* 2006).

**Notes.** While some species of *Seringia* J.Gay (a genus also in the tribe *Lasiopetaleae*) may also have winged fruits (Wilkins & Chappill 2002b), the wings form along (rather than between) the lines of

dehiscence as seen in *L. pterocarpum*. The epidermal cell pattern on the seed exotesta is similar to that observed in *L. compactum* Paust and the aril belongs to subtype 3a of Wilkins and Chappill (2002b).

***Lasiopetalum rutilans* K.A.Sheph. & C.F.Wilkins, *sp. nov.***

*Type:* Mount Lesueur National Park, Western Australia [precise locality withheld for conservation reasons], 23 August 2016, *K.A. Shepherd & C.F. Wilkins* KS 1601 (*holo:* PERTH 08858128; *iso:* BRI, CANB, K, MEL, NSW).

*Lasiopetalum* sp. Mount Lesueur (E.A. Griffin 1997), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 30 August 2016].

Erect, rounded *shrub* 0.4–1.8 m high, 1.5–1.8 m wide. *Young stems* with moderately dense, red, stellate hairs, mainly sessile or with a stalk to 0.3 mm long and 8–12 arms, each to 1.5 mm long, and occasional glandular hairs to 0.8 mm long, with or without occasional, small, white, stellate hairs and red glands to 0.1 mm long; mature stems red-brown, glabrescent. *Petioles* 3.3–14.5 mm long, indumentum as for young stems. *Mature leaf blades* soft, ovate, scarcely discoloured, 8–28 mm long, 6–22 mm wide, base cordate, apex acute; margin entire to sinuate, flat or scarcely recurved; abaxial surface with scattered to moderately dense, tan-centred, white or red, stellate hairs with 8–12 arms, each 0.9–1 mm long, and occasionally with scattered glands to 0.1 mm long on midrib; adaxial surface with scattered to moderately dense, cream-brown, stellate hairs with 6–12 arms, each to 1.3 mm long, glandular hairs absent. *Inflorescence* a loose dichasium, 38–83 mm long, with 6–15 flowers; *peduncles* 19–57 mm long, with scattered, stalked (*c.* 0.2 mm long) or sessile, bright red, or pinkish-brown, stellate hairs with 8–10 arms, each to 1.8 mm long, over scattered, white, stellate hairs with *c.* 8 rarely rotate arms, each to 0.3 mm long and with or without occasional, glandular hairs to 1 mm long. *Pedicels* 3.5–9.8 mm long, indumentum as for peduncles. *Bract* narrowly ovate, 1.8–5.7 mm long, 0.35–0.7 mm wide. *Epicalyx* bract attachment 0.4–0.9 mm below the calyx, narrowly ovate, 0.8–2.5 mm long, 0.2–0.7 mm wide; abaxial surface and margin with occasional, white, stellate hairs with 6–8 arms, each to 1.5 mm long and with or without scattered, white, stellate hairs with *c.* 6 arms, each to 0.3 mm long; adaxial surface glabrous or with an occasional, white, stellate hairs with *c.* 6–10 arms, each to 0.3 mm long. *Calyx* pale pink, base dark red with green at the lobe junctions, 6.1–7.5 mm long, with a tube 0.7–1.2 mm long; lobes narrowly ovate, 6–6.1 mm long, (1.7–)2–2.8 mm wide, apex acute; outer surface with scattered, red, stellate hairs with *c.* 9–10 arms, each to 1.5 mm long at the base and margins, over white stellate hairs with *c.* 8 arms, each to 0.15 mm long, mainly towards base of the calyx or lobe margins only and with occasional glandular hairs to 0.8 mm long; inner surface glabrous. *Staminal filaments* 0.2–0.5 mm long, 0.15–0.2 mm wide. *Anthers* ovate, red-purple, 1.3–1.8 mm long, 0.7–0.8 mm wide. *Ovary* 0.8–1 mm long, 0.8–1 mm wide; outer surface with dense, white, stellate hairs to 0.15 mm long and scattered glandular hairs to 0.15 mm long. *Style* 2.5–4.8 mm long. *Fruit* an ellipsoid capsule, *c.* 4 mm long, *c.* 4 mm wide, with residual moderately dense, small, white, stellate hairs and scattered glandular hairs. *Seed* ellipsoid, dull, blackish brown with few stellate hairs, *c.* 2.6 mm long, *c.* 1.3 mm wide; aril a white cap with two arms, *c.* 1.3 mm long, *c.* 0.8 mm wide. (Figure 11)

*Diagnostic features.* *Lasiopetalum rutilans* is distinguished within the *L. floribundum* group by the presence of bright red, stellate hairs evident on new growth of the stem, outer surface of calyx, pedicels and peduncle, and in having broad calyx lobes (2–2.8 mm wide).

*Selected specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 24 Dec. 1993, *B. Evans* WE 802 (PERTH); 16 Oct. 1946, *C.A. Gardner* 8468 (PERTH);



Figure 11. *Lasiopetalum rutilans*. A – habit; B – loose, dichasial inflorescence; C – ovate leaf, showing bright red, stellate hairs on new growth and scattered on the adaxial leaf surface; D – outer surface of calyx showing scattered, bright red, stellate hairs towards the base of each lobe, and red pedicel with stellate and glandular hairs; E – flowers showing the dark red base with green at the junction of each pink, petaloid, calyx lobe. Vouchers: *C.F. Wilkins & J.A. Wege* CW 2383 (A, D, E); *K.A. Shepherd & C.F. Wilkins* KS 1601 (B, C). Photographs by J.A. Wege (A, D, E) and K.A. Shepherd (B, C).

13 Sep. 1999, *M. Hislop* 1498 (PERTH); 26 Sep. 1976, *R.W. Johnson* 3289 (PERTH); 3 Nov. 1962, *R.D. Royce* 7713 (PERTH); 10 Sep. 2011, *K.R. Thiele* 4232 (PERTH); 16 Sep. 2010, *C.F. Wilkins & J.A. Wege* CW 2383 (PERTH).

*Phenology.* Recorded as flowering and fruiting from August to December.

*Distribution and habitat.* *Lasiopetalum rutilans* is restricted to a few populations within Mount Lesueur National Park, and scattered collections from unreserved lands between the town of Jurien Bay and Alexander Morrison National Park (Figure 7) in the Geraldton Sandplains bioregion (IBRA7; Department of the Environment 2013). It is found in open marri woodland or Kwongan heath on lateritic brown sand, white sand, or skeletal soil over sandstone, on upper slopes or valley floors.

*Conservation status.* *Lasiopetalum rutilans* is listed by Smith (2017) as Priority Two under Department of Parks and Wildlife Conservation Codes for Western Australian Flora, under the name *L. sp.* Mount Lesueur (E.A. Griffin 1997).

*Etymology.* The epithet is from the Latin *rutilans* (bright red), in reference to the distinctive colour of the stellate hairs evident on new leaf growth, peduncles and the outer surface of the calyx of this species (Figure 11).

*Affinities.* Refer to the comparative notes under the affinities section for *L. moullean* and *L. floribundum*.

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## SHORT COMMUNICATION

***Ptilotus benlii* (Amaranthaceae), a new species from Western Australia**

***Ptilotus benlii*** R.W.Davis & T.Hammer, *sp. nov.*

*Type:* 15 km east along Northampton – Port Gregory Road from junction of Yerina Springs Road, c. 20 km north-west of Northampton, Western Australia, 3 October 2005, R. Davis 10952 (*holo:* PERTH 07200773; *iso:* CANB).

*Ptilotus* sp. Northampton (R. Davis 10952), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 22 February 2017].

Erect *perennial herbs* to 45 cm high. *Stems* arising from an underground woody rootstock, terete, ribbed, glabrous, or rarely with very sparse, ascending, nodose hairs. *Cauline leaves* narrowly oblanceolate, 10–60 mm long, 1–4 mm wide, glabrous. *Inflorescences* terminal, spiciform, cylindrical, 20–48 mm long, (25–)28–34 mm wide, white-green. *Bracts* ovate, 5.5–7.1 mm long, 3–3.2 mm wide, transparent, glabrous; apex mucronate (mucro 0.3–0.5 mm long). *Bracteoles* broadly ovate, 5.5–7.7 mm long, 3.8–5 mm wide, transparent, with sparse, nodose hairs along midrib; apex mucronate (mucro 0.3–0.5 mm long). *Tepals* narrowly lanceolate, slightly in-rolled, 13–16 mm long, 1.1–1.8 mm wide; apex entire, green; outer surface with long, silky, nodose hairs to 5 mm long, apex glabrous; inner tepals with marginal woolly hairs at the base of the inner surface to 4 mm long. *Fertile stamens* 5; *filaments* 6.3–7 mm long, uneven, dilated towards the base, pink; *anthers* 1–1.5 mm long, 0.5–0.6 mm wide, pink. *Staminal cup* 2–2.1 mm long, symmetrical, lobed. *Staminal cup appendages* 2–2.3 mm long, 0.4–0.6 mm wide, with sparse hairs on both surfaces. *Ovary* obconical, 1.1–1.2 mm long, 1.1–1.3 mm wide, glabrous. *Stipe* 1–1.2 mm long. *Style* straight, 5.5–7.3 mm long, centrally fixed to ovary. *Stigma* capitate. *Seed* not seen. (Figure 1)

*Diagnostic features.* *Ptilotus benlii* may be distinguished from all other members of the genus by the following combination of characters: an erect, perennial herb; large, white-green spikes, 28–35 mm wide; five, pink stamens with staminal cup appendages.

*Other specimens examined.* WESTERN AUSTRALIA: track W of rail-line, 600 m S of Canna, 16 Oct. 2013, G. Byrne 589 (PERTH); junction of Chandler-Nungarin Road and Talgomine-Reserve Road, 8 Nov. 2014, R. Davis 12505 & K.R. Thiele (PERTH); 18 km S of Youanmi, 22 Nov. 1978, H. Demarz D 7256 (CANB, PERTH); Garth Kowald's Avenue, 2 km E of Mullewa Shire boundary, Tardun, 13 Oct. 2007, J. Docherty 453 (PERTH); Ellendale Road, 3.5 km S of Ramsay Road, E of Greenough, 5 Dec. 2005, M. Hislop 3550 (PERTH); northern end of Hutt Lagoon, NE of Port Gregory, 6 Nov. 2008, G.J. Keighery 17476 (PERTH); Lot 3157, Isseka Road East, Northampton, 25 Oct. 1999, I.B. Shepherd 198 (PERTH).

*Phenology.* Flowering from mid-spring to late spring. Fruiting from late spring to early summer.



Figure 1. *Ptilotus benlii*. A – flowering plant *in situ* showing the erect habit and green-white flowers; B – flower, showing the characteristic pink filaments and anthers. Images from R. Davis 10952. Photographs by R. Davis.

**Distribution and habitat.** *Ptilotus benlii* occurs from west of Northampton, south-east to Nungarin in the central wheat-belt, and east to the Murchison bioregion near Youanmi Station, 125 km south-east of Mt Magnet (Figure 2). It is often found growing on red or yellow clayey sands in open *Acacia* scrub with *A. rostellifera* or in open mallee woodlands.

**Conservation status.** *Ptilotus benlii* can be found over a wide area on a range of habitats and appears not to be under any immediate threats; however, it is under-collected to the far east and south-east of its range.

**Etymology.** The epithet acknowledges the significant contribution of German botanist Gerhard Benl (1910–2001) to the taxonomy of *Ptilotus* R.Br. His work on the genus spanned 40 years, during which time he described upwards of 30 species and numerous infraspecific taxa, and prepared a draft manuscript for the genus for *Flora of Australia*.

**Notes.** The chloroplast *matK* and nuclear ITS markers have been sequenced for *P. benlii* for a forthcoming PhD thesis (Hammer, in prep.). A preliminary phylogeny including this species has placed it as sister to *P. esquamatus* (Benth.) F.Muell., in a basal position to the '*P. drummondii* clade' (including *P. drummondii* (Moq.) F.Muell., *P. schwartzii* Tate, *P. aphyllus* Benl and *P. calostachyus* F.Muell.). *Ptilotus benlii* shares the character of staminal cup appendages with these species, but can be readily distinguished based on its larger, green-white flowering spikes and bright pink filaments and stamens. *Ptilotus esquamatus* differs from *P. benlii* in having pink spikes, bright orange staminal cup nectaries, and in lacking staminal cup appendages. All other species in this group have pink flowers, or if green, then much smaller spikes.

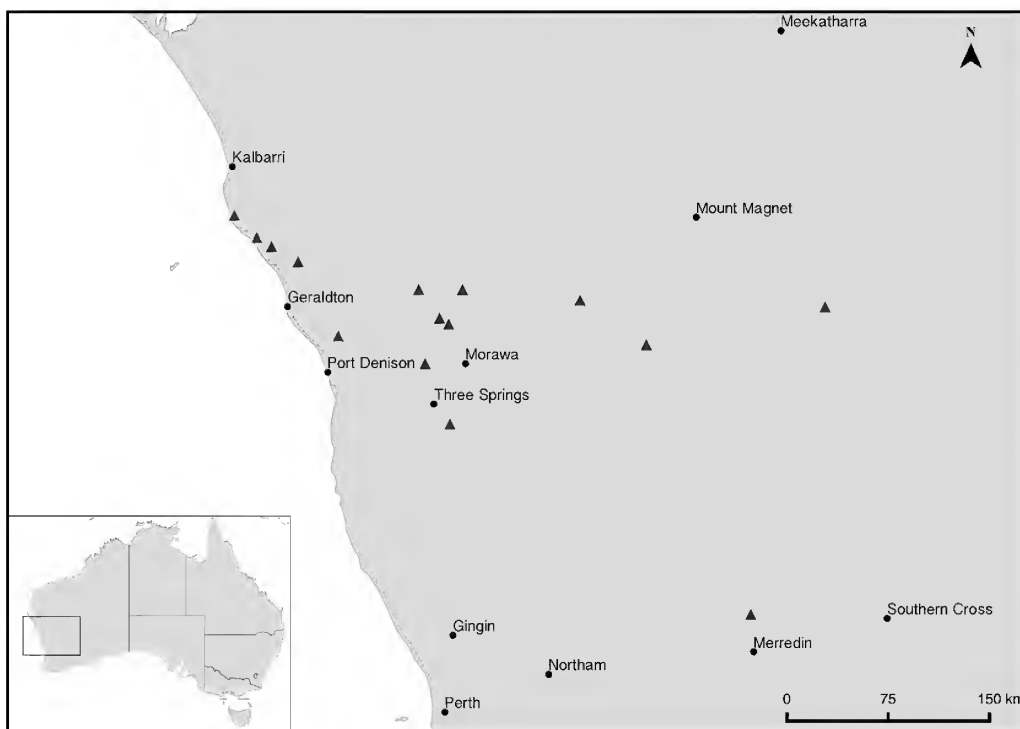


Figure 2. Distribution of *Ptilotus benlii* (▲) in Western Australia.

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## A taxonomic update of *Brachyloma* (Ericaceae: Epacridoideae: Styphelioideae) in Western Australia

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### Abstract

Hislop, M. & Cranfield, R.J. A taxonomic update of *Brachyloma* (Ericaceae: Epacridoideae: Styphelioideae) in Western Australia. *Nuytsia* 28: 303–316. Three new Western Australian species of *Brachyloma* Sond., *B. djerral* Cranfield & Hislop, *B. elusum* Hislop & Cranfield and *B. pirara* Cranfield & Hislop, are described and illustrated. All three are of conservation concern. A new combination, *B. geissoloma* (F.Muell.) Cranfield, is published to replace the illegitimate name *B. concolor* F.Muell. ex Benth. The following manuscript names are synonymised: *B. ericoides* subsp. *occidentale* Cranfield ms, *B. geissoloma* subsp. *collinum* Cranfield ms, *B. geissoloma* subsp. *ovatum* Cranfield ms and *B. moolya* Cranfield ms under *B. geissoloma*; *B. jillup* Cranfield ms, *B. preissii* subsp. *lanceolatum* Cranfield ms, *B. preissii* subsp. *obtusifolium* Cranfield ms and *B. tamminense* Cranfield ms under *B. preissii* Sond. A lectotype is designated for *B. preissii*. An updated key to the Western Australian species of *Brachyloma* is provided.

### Introduction

Recent molecular research (Puentes-Lelièvre *et al.* 2016) has supported the monophyly of the small epacrid genus *Brachyloma* Sond. Parsimony and Bayesian analyses of DNA sequence data produced a phylogenetic tree that showed a sister relationship between the genus and a clade comprising the genera *Conostephium* Benth. and *Stenanthera* R.Br. Within *Brachyloma* the species sampled were divided between two well-supported subclades that corresponded with Bentham's (1868) sections: the type section (which he referred to as sect. *Lobopogon* (Schltdl.) Benth. *nom. illeg.*) and sect. *Lissanthoides* Benth. As discussed in a previous paper (Hislop & Cranfield 2014) this dichotomy is generally well corroborated by morphological differences and there is a growing case for elevating the sections to generic level. The distribution of species from the two sections shows a distinct geographical bias, with most members of the type section from Western Australia, and the majority of those from sect. *Lissanthoides*, eastern Australian.

The current paper updates the taxonomy of the genus in Western Australia, providing formal names for the remaining well-defined taxa, while synonymising a number of manuscript names. The latter had been applied by the second author to putative segregates from a difficult species complex involving *B. preissii* Sond. and *B. geissoloma* (F.Muell.) Cranfield.

The three species described below bring to sixteen the number of currently accepted, published species in the genus. Of the ten Western Australian species, only two, *B. baxteri* (DC.) Puentes-Lel.

and *B. stenolobum* Hislop & Cranfield, belong to sect. *Lissanthoides*; the remainder are from the type section.

## Methods

This study was based on an examination of dried specimens housed at the Western Australian Herbarium (PERTH), together with field observations of the species described and their relatives in Western Australia.

Foliar measurements and observations were taken from dried specimens in natural posture. Care was taken to confine observations to mature leaves. Inflorescence length was measured from the point of attachment at the axil to flower base. Floral measurements were taken from rehydrated flowers in natural posture, with the exception of the corolla lobes which were uncurled to their fullest length before measuring.

Type specimens were obtained on loan from MEL. Scans of other relevant types were viewed via *Global Plants* (<http://plants.jstor.org/>).

Bioregions and subregions referred to in the text and shown on distribution maps follow *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 (Department of the Environment 2013).

## Notes on the *Brachyloma preissii*–*B. geissoloma* complex

*Brachyloma preissii* and *B. geissoloma* are closely related species, the two occupying a sister relationship in a recently published phylogenetic tree (Puente-Lelièvre *et al.* 2016). They have in common a distinctive stamen morphology that is characterised by broad, fleshy filaments and anthers that are well-exserted from the corolla tube. In addition they have a distinctive, longitudinally grooved, fruiting endocarp. The eastern Australian species, *B. ericoides* (Schltdl.) Sond., shares these attributes, but with the filaments even wider and rather thinner in texture. On this basis it seems likely that *B. preissii* and *B. geissoloma* are more closely related to *B. ericoides* than to the other western members of the genus.

*Brachyloma preissii* (plus the very similar *B. mogin* Cranfield) and *B. geissoloma* differ most obviously in leaf curvature; adaxially convex in the former and concave in the latter. Specimens now assigned to these species (more than 250 at PERTH) vary considerably in leaf size and shape, and, to some extent, in the size of floral parts and peduncle length. However, the identification of consistent floral or fruiting differences that might correlate with the foliar characters has so far proved to be a stumbling block to taxonomic progress in the group.

The *B. preissii*–*B. geissoloma* complex was examined as part of wider research into the taxonomy of the genus undertaken by the second author in the late 1990s and early 2000s. This resulted in the publication of one new species, *B. mogin* (Cranfield 2005), and a proposal for another eight taxa (*B. ericoides* subsp. *occidentale* Cranfield ms, *B. geissoloma* subsp. *collinum* Cranfield ms, *B. geissoloma* subsp. *ovatum* Cranfield ms, *B. jillup* Cranfield ms, *B. moolya* Cranfield ms, *B. preissii* subsp. *lanceolatum* Cranfield ms, *B. preissii* subsp. *obtusifolium* Cranfield ms and *B. tamminense* Cranfield ms). However, the putative taxonomic boundaries between these segregates have not held up to scrutiny of the increased numbers of collections that are now housed at PERTH. For this reason the names are synonymised below either under *B. preissii* or *B. geissoloma*, depending on their leaf curvature, as indicated above. It is now recognised that it will be necessary to undertake further targeted research, in order to more

satisfactorily delimit taxa within the complex. The question of whether *B. mogin* can be retained as a species distinct from *B. preissii*, and if so with what circumscription, will need to be considered as part of any future study. For the time being the name is retained for plants with relatively small and tightly recurved leaves.

## Taxonomy

### Key to the Western Australian species of *Brachyloma*

1. Corolla red or white; lobes narrowly triangular, acute, adaxially keeled in the upper half, strongly papillate or shortly hairy, at least about the keel (sect. *Lissanthoides*)
2. Corolla red; tube > 10 mm long; 5 hairy appendages inserted close to the base of the corolla tube (Lake Muir–Fitzgerald River)..... **B. baxteri**
- 2: Corolla white; tube to 1.6 mm long; appendages lacking from corolla tube, 5 hair tufts reflexed into the tube from the lobe bases (Forrestania area)..... **B. stenolobum**
- 1: Corolla red; lobes ovate or broadly ovate, usually obtuse, very occasionally subacute or acute, adaxial surface flat, appearing glabrous, but usually minutely papillose under magnification (sect. *Brachyloma*)
3. Anthers partially included within the corolla tube; filaments absent or short and inconspicuous, to c. 0.4 mm long
4. Leaves flat or adaxially convex, less often adaxially concave, if convex then the margins not prominently recurved and the abaxial surface always visible, apex long-mucronate and sharply pungent; sepals at least 2 mm long
5. Leaf margins coarsely ciliate with stiff hairs 0.08–0.20 mm long; sepals 3.0–3.6 mm long; style poorly differentiated from ovary apex, to 0.55 mm long; drupe globose, about as long as wide (Whicherina–East Binu–Kalbarri NP)..... **B. pirara**
- 5: Leaf margins usually with minute projections to c. 0.02 mm long, or occasionally ± smooth; sepals 2.0–2.4 mm long; style well-differentiated from ovary apex, 1.0–2.2 mm long; drupe depressed-ovate, much wider than long (Ajana–Nerren Nerren)..... **B. djerral**
- 4: Leaves always strongly convex adaxially, the margins recurved or revolute, partially obscuring the abaxial surface in some or all leaves, apex short- or long-mucronate, but not pungent; sepals to 1.5 mm long
6. Anthers exerted from the corolla tube by 1/8–1/4 of their length, sessile; style poorly differentiated from ovary apex, to 0.5 mm long; leaves 0.5–1.2 mm wide
7. Longest leaves to c. 8.0 mm long, including petiole; abaxial surface with deep, narrow grooves (Kulin area) ..... **B. delbi**
- 7: Longest leaves to c. 5.5 mm long, but usually < 5.0 mm, including petiole; abaxial grooves shallower and wider than above (Newdegate–Forrestania–Cascade) ..... **B. nguba**
- 6: Anthers exerted from the corolla tube by 1/2–2/3 of their length, with short filaments 0.2–0.4 mm long; style clearly differentiated from ovary apex, 1.3–2.0 mm long; leaves 1.0–2.0 mm wide (NE of Naremben–Hyden)..... **B. elusum**
- 3: Anthers fully exerted from corolla tube; filaments conspicuous, concavo-convex or less often plano-convex in section, fleshy, tapering at both ends, at least 1 mm long
8. Leaves adaxially concave..... **B. geissoloma s. lat.**<sup>1</sup>

- 8:** Leaves adaxially convex, usually with recurved margins but sometimes  $\pm$  flat..... **B. preissii s. lat.** (including **B. mogin**)<sup>1</sup>

<sup>1</sup>*Brachyloma preissii* and *B. geissoloma* together constitute an unresolved species complex (refer to notes above) that requires further study.

## Descriptions of new species

### **Brachyloma djerral** Cranfield & Hislop, *sp. nov.*

*Typus:* [north-east of Kalbarri], Western Australia [precise locality withheld for conservation reasons], 8 June 2005, *M. Hislop* 3459 (*holo:* PERTH 07011571; *iso:* CANB, K, MEL, NSW).

*Brachyloma djerral* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma* sp. Murchison (A.P. Brown 312), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

Erect, compact *shrubs* to *c.* 1.2 m high and 1.2 m wide, multi-stemmed from the base of the plant, but probably with a fire-sensitive rootstock. Young *branchlets* with a sparse indumentum of very short, patent hairs to *c.* 0.05 mm long, or sometimes  $\pm$  glabrous. *Leaves* variously orientated from shallowly retrorse to steeply antrorse; apex long-mucronate, pungent, the mucro 0.4–0.8 mm long; base cuneate to rounded; petiole well-defined, 0.4–1.0 mm long, shortly hairy throughout or abaxial surface glabrous; lamina narrowly obovate to narrowly elliptic, 4–7 mm long, 1.4–2.4 mm wide, usually adaxially convex and the margins  $\pm$  recurved or less often  $\pm$  flat, longitudinal axis straight for most of its length, but usually gently recurved towards the apex; surfaces glaucous, markedly discolorous, glabrous except sometimes for a few basal hairs on either surface; adaxial surface becoming shiny through abrasion, venation not evident; abaxial surface paler, with 5–7 primary veins,  $\pm$  flat or broadly and shallowly grooved between the veins; margins usually with minute, coarse projections < 0.05 mm long or occasionally  $\pm$  glabrous. *Inflorescence* erect, upper-axillary; axis 0.8–1.3 mm long, 1-flowered, moderately hairy, terminating in the flower, bud-like rudiment absent. *Fertile bracts* very variable in size, ovate to depressed-ovate, 0.2–0.8 mm long, 0.2–0.6 mm wide, subtended by 7–10 sterile bracts. *Bracteoles* broadly ovate to depressed-ovate, 1.0–1.8 mm long, 1.3–1.9 mm wide, obtuse; abaxial surface glabrous,  $\pm$  striate; margins ciliolate. *Sepals* ovate to broadly ovate, 2.0–2.4 mm long, 1.5–2.2 mm wide, obtuse; abaxial surface glabrous, greenish, becoming red towards margins,  $\pm$  striate with 7–9 slightly raised veins; adaxial surface glabrous; margins densely ciliolate with hairs 0.03–0.08 mm long. *Corolla tube* red, ellipsoid or broadly ellipsoid, sometimes obovoid, much exceeding the sepals, 3.2–4.5 mm long, 2.8–3.5 mm wide, glabrous externally, internal surface glabrous apart from 5 reflexed, hairy appendages inserted at the apex; appendages 1.2–1.8 mm long, 0.7–1.2 mm wide with hairs 0.2–0.7 mm long concentrated on the margins but with a few often present on both surfaces. *Corolla lobes* red, ovate to broadly ovate, shorter than the tube, 1.8–2.7 mm long, 1.4–2.3 mm wide, imbricate basally, obtuse, flat adaxially, erect basally, recurved in the upper half, with margins often sparsely and irregularly ciliolate, glabrous externally, internal surface minutely papillose. *Anthers* yellow, partially exserted from the tube (by 1/3–1/2 of their length), 1.0–1.6 mm long, the lateral surfaces papillose, apex shallowly emarginate. *Filaments* very short and broad-based, to *c.* 0.2 mm long or  $\pm$  obsolete, attached 1/2–2/3 above anther base. *Nectary* annular, 0.4–0.5 mm long, irregularly lobed for 1/4–1/2 of its length. *Ovary* depressed-globose, 0.9–1.3 mm long, 1.2–1.8 mm wide, glabrous, 4- or less often 5-locular. *Style* 1.0–2.2 mm long, glabrous, well-differentiated from ovary apex, included within the corolla tube; stigma not expanded. *Fruit* strongly depressed-ovoid, much

longer than calyx, 3.0–6.0 mm long, 5.0–7.5 mm wide, glabrous, often  $\pm$  angular at maturity; surface rugose; style usually persistent. (Figures 1, 2A)

*Diagnostic characters.* Distinguished from all other members of the genus by the following character combination: very short, sparse branchlet indumentum to *c.* 0.05 mm long; leaf margins with very short, coarse projections; sepals much shorter than the corolla tube; anthers partially exserted from the corolla tube; filaments very short and broad-based or  $\pm$  obsolete; style well-differentiated from the ovary apex and 1.0–2.2 mm long; fruit strongly depressed-ovoid.

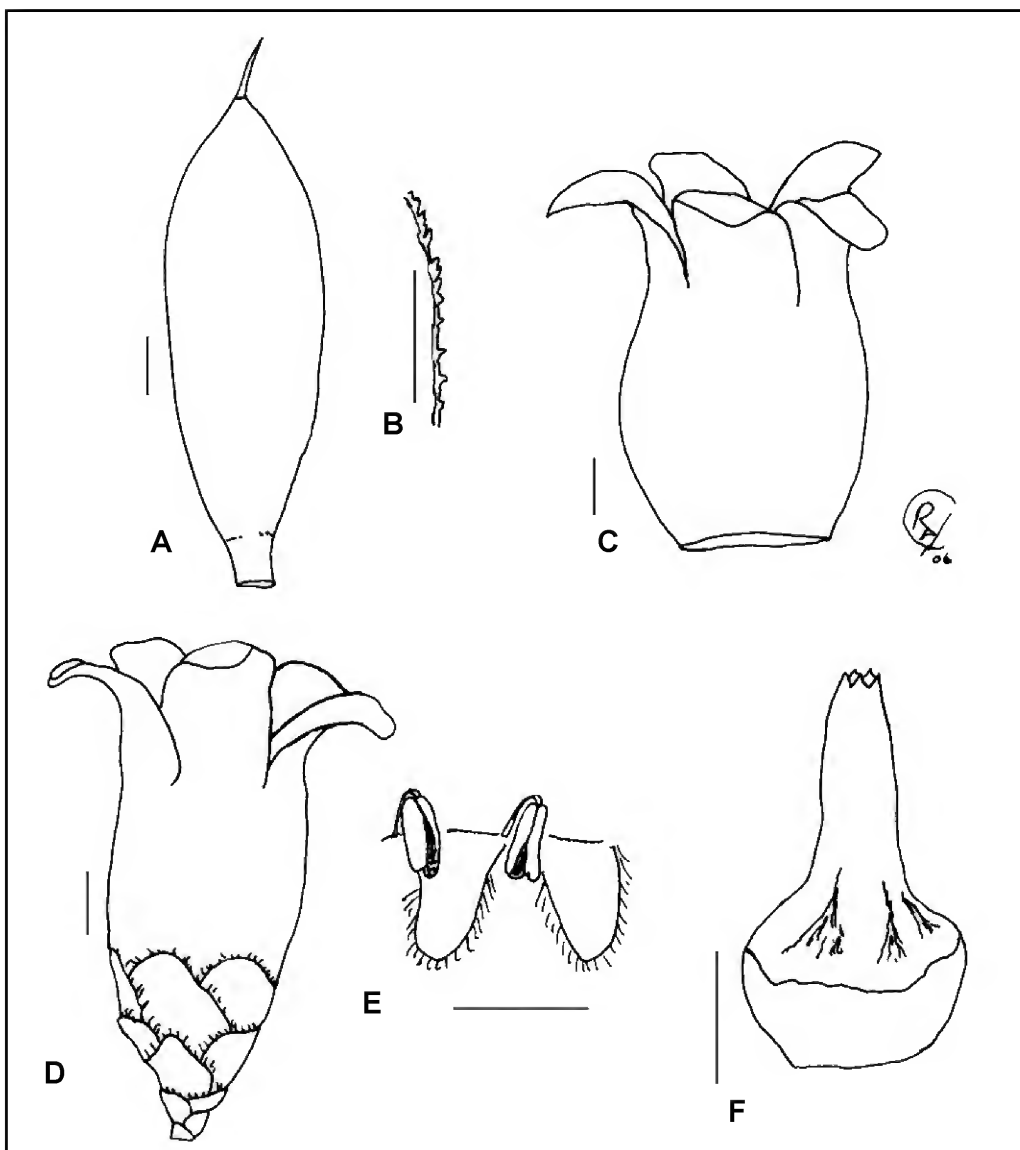


Figure 1. *Brachyloma djerral*. A – leaf; B – detail of leaf margin; C – corolla, external view; D – flower, including bracts, bracteoles and sepals; E – internal corolla tube, part of upper portion showing two anthers and two reflexed appendages; F – gynoecium. Scale bars = 1 mm. Drawn by Ray Cranfield from M. Hislop 3468.

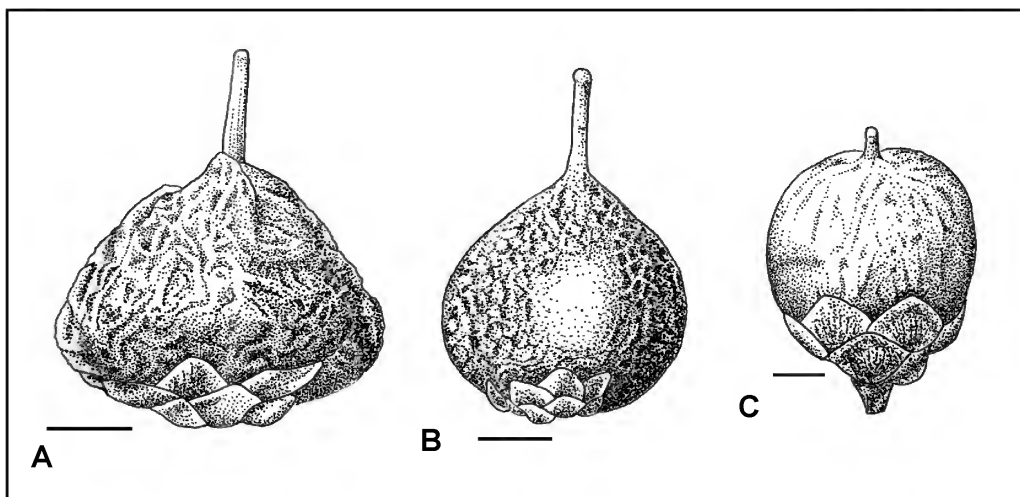


Figure 2. *Brachyloma* fruits. A – *B. djerral*; B – *B. elusum*; C – *B. pirara*. Scale bars = 2 mm. Drawn by Skye Coffey from *M. Hislop* 3448 (A), *A.S. George* 7877 (B), *M. Hislop* 4635 (C).

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 7 Aug. 1986, *A.P. Brown* 312 (PERTH); 30 Aug. 1990, *A.H. Burbidge* 4504 (PERTH); 8 June 2005, *M. Hislop* 3456 (PERTH); 8 June 2005, *M. Hislop* 3457 (CANB, K, MEL, PERTH); 8 June 2005, *M. Hislop* 3462 (CANB, NSW, PERTH); 9 June 2005, *M. Hislop* 3468 (CANB, PERTH); 9 June 2005, *M. Hislop* 3469 (CANB, PERTH); 4 Aug. 1996, *G.J. Keighery & N. Gibson* 1829 (CANB, PERTH); 6 Sep. 1966, *R.V. Smith* 66/302 (MEL, PERTH).

*Distribution and habitat.* Apparently confined to an area between Ajana and Nerren Nerren in the Geraldton Hills sub-region of the Geraldton Sandplains bioregion and the immediately adjoining parts of the Yalgoo bioregion (Figure 3). The species is restricted to yellow sandplain where it grows in low, open woodland and heath communities. Commonly associated species include *Eucalyptus eudesmoides*, *E. oldfieldii*, *Banksia sceptrum*, *Callitris arenarius* and *Allocasuarina campestris*.

*Phenology.* In average seasonal conditions peak flowering is likely to be between May and July, although there are indications that the species may flower sporadically at other times of the year. A mostly-fruited collection made in September has a few flowers present, and a couple of specimens collected in June, although more or less in full flower, also have some mature fruit.

*Etymology.* The epithet is from the Noongar language of the traditional inhabitants of the area (*djerral*, meaning the north: Bindon & Chadwick 1992), a reference to the northern distribution of this species.

*Conservation status.* Recently listed as Priority Three under Conservation Codes for Western Australian Flora (Western Australian Herbarium 1998–). Although occurring in a part of the state in which there are still large areas of more or less intact vegetation, *B. djerral* is geographically restricted. There is one record from the north-east of Kalbarri National Park, and the species is also known to be present at Eurardy Reserve, a privately owned and managed conservation reserve adjacent to Kalbarri National Park. The remaining collections are from Unallocated Crown Land or pastoral lease. Populations of the species tend to consist of scattered plants and it is not known to be locally common anywhere.

*Affinities.* The phylogenetic tree of Puente-Lelièvre *et al.* (2016) showed a well-supported sister

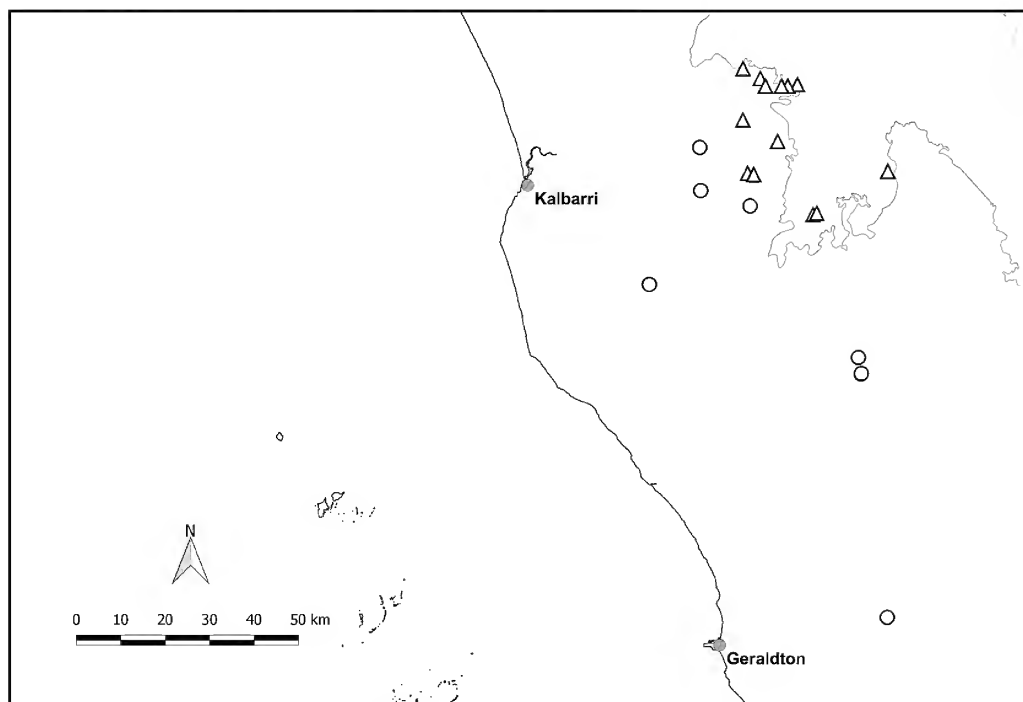


Figure 3. Distribution of *Brachyloma djerral* ( $\Delta$ ) and *B. pirara* ( $\circ$ ) in the central west coast area of Western Australia.

relationship between *B. djerral* and *B. pirara* Cranfield & Hislop, described below. These species grow in very similar habitat in the same area of the Geraldton Sandplains bioregion; however, the two are morphologically quite distinct with many significant differences between them. Rather unusually among closely related epacrids, they can even be distinguished on the basis of their vegetative indumentum. Whereas *B. djerral* has a very short, sparse branchlet indumentum (hairs to c. 0.05 mm long) and leaf margins with minute projections (to c. 0.02 mm long), in *B. pirara* the indumentum is much longer and denser (hairs to 0.1–0.7 mm long) and the leaf margins are coarsely ciliate with hairs 0.08–0.20 mm long. In terms of floral and fruiting characters there are significant differences in the style (well-differentiated from the ovary apex and 1.0–2.2 mm long in *B. djerral*, cf. poorly differentiated and 0.35–0.55 mm long in *B. pirara*) and fruit shape (strongly depressed-ovate in *B. djerral* and globose in *B. pirara*). Other easily discernible differences between them include the shorter sepals of *B. djerral* (2.0–2.4 mm long cf. 3.0–3.6 mm), and obtuse (*B. djerral*) rather than acute or subacute (*B. pirara*) corolla lobes.

Despite the shared habitat preference and overlapping distributions of these two northern species, there are no records of them growing sympatrically.

***Brachyloma elusum* Hislop & Cranfield, *sp. nov.***

*Typus*: east of Hyden, Western Australia [precise locality withheld for conservation reasons], 24 April 2016, M. Hislop 4595 (*holo*: PERTH 08753016; *iso*: CANB, MEL, NSW).

Erect, compact *shrubs* to c. 80 cm high and 80 cm wide, multi-stemmed from the base of the plant, but probably with a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of short, patent or shallowly antrorse hairs to c. 0.08 mm long. *Leaves* variously antrorse;

apex obtuse to acute, with a short, slightly recurved, blunt mucro, 0.1–0.3 mm long; base attenuate to cuneate; petiole well-defined, 0.7–1.1 mm long, sparsely hairy throughout or the abaxial surface glabrous; lamina linear or very narrowly obovate, 4.2–7.5 mm long, 1.0–2.0 mm wide, strongly convex with the margins recurved to revolute, longitudinal axis  $\pm$  straight; surfaces glaucous, markedly discolorous; adaxial surface slightly shiny,  $\pm$  glabrous or with a few short antrorse hairs, venation not evident; abaxial surface paler with 5–7 primary veins, broadly and shallowly grooved, with very short, appressed, scurfy hairs between the veins; margins with minute, coarse, antrorse projections,  $<0.05$  mm long. *Inflorescence* erect to spreading, axillary; axis 0.9–1.8 mm long, 1-flowered, moderately hairy, terminating in a very obscure bud-like rudiment that is completely concealed by the subtending bracts, or bud-like rudiment absent. *Fertile bracts* broadly ovate, 0.4–0.6 mm long, 0.4–0.6 mm wide, subtended by 7 or 8 sterile bracts. *Bracteoles* depressed-ovate, 0.7–1.0 mm long, 0.9–1.1 mm wide, obtuse; abaxial surface glabrous; margins ciliate. *Sepals* broadly ovate to depressed-ovate, 1.0–1.5 mm long, 1.0–1.5 mm wide, obtuse; abaxial surface glabrous, greenish, often with red tinges towards the margins, venation rather inconspicuous; adaxial surface glabrous; margins minutely ciliate, with hairs  $<0.02$  mm long. *Corolla tube* red, ovoid to ellipsoid, much exceeding the sepals, 2.4–3.5 mm long, 1.9–3.0 mm wide, glabrous externally, internal surface with 5 reflexed, hairy appendages inserted at the apex; appendages 0.6–0.9 mm long, 0.3–0.5 mm wide, scarcely tapering to an obtuse apex, adnate to the tube for most or all of their length, with hairs 0.3–0.7 mm long concentrated on the margins, often with decurrent lines of hairs extending from the base of the appendages to the top of the tube behind the point of filament attachment. *Corolla lobes* red, ovate, shorter than the tube, 1.8–2.2 mm long, 1.3–1.8 mm wide, imbricate basally, obtuse, flat adaxially, erect basally, recurved in the upper half with  $\pm$  glabrous margins, glabrous externally, internal surface minutely papillose. *Anthers* yellow, partially exerted from the tube (by  $1/2$ – $2/3$  of their length), 0.8–1.5 mm long, the lateral surfaces papillose, apex  $\pm$  entire to shallowly emarginate. *Filaments* short, thick, compressed, the free portion 0.2–0.4 mm long, attached *c.*  $1/2$  above anther base with a broad, decurrent connective. *Nectary* annular, 0.2–0.4 mm long,  $\pm$  entire to deeply lobed. *Ovary* ovate to globose, 1.0–1.1 mm long, 0.8–1.0 mm wide, glabrous, (3)4-locular. *Style* 1.3–2.0 mm long, minutely papillose towards the apex, well-differentiated from ovary apex, included within the corolla tube; stigma not or scarcely expanded. *Fruit* broadly ovoid, much longer than calyx, 4.5–6.0 mm long, 4.5–6.0 mm wide, glabrous, surface rugose; style usually persistent. (Figures 2B, 4)

*Diagnostic characters.* Distinguished from all other members of the genus by the following character combination: recurved to revolute leaf margins; sepals much shorter than the corolla tube; anthers partially exerted from the corolla tube; filaments short, 0.2–0.4 mm long; style well-differentiated from the ovary apex and 1.3–2.0 mm long; fruit broadly ovoid.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 15 June 2005, *C. Hancock s.n.* (PERTH 08383685); 11 July 2004, *M. Hislop* 3262 (PERTH); 12 Sep. 2016, *M. Hislop* 4635 (CANB, PERTH).

*Distribution and habitat.* Known from two localities, one north-east of Narembreen, the other east of Hyden in the Avon Wheatbelt and Mallee bioregions respectively. At both localities the species is growing on yellow sandy soils with granite at depth, and the associated vegetation is tall heathland dominated by *Allocasuarina campestris* and *Melaleuca* spp.

*Phenology.* Flowering collections have been made between April and July, with the onset of flowering probably determined by the pattern of local rainfall in the late summer and autumn months. The only collection with mature fruit was made in September.

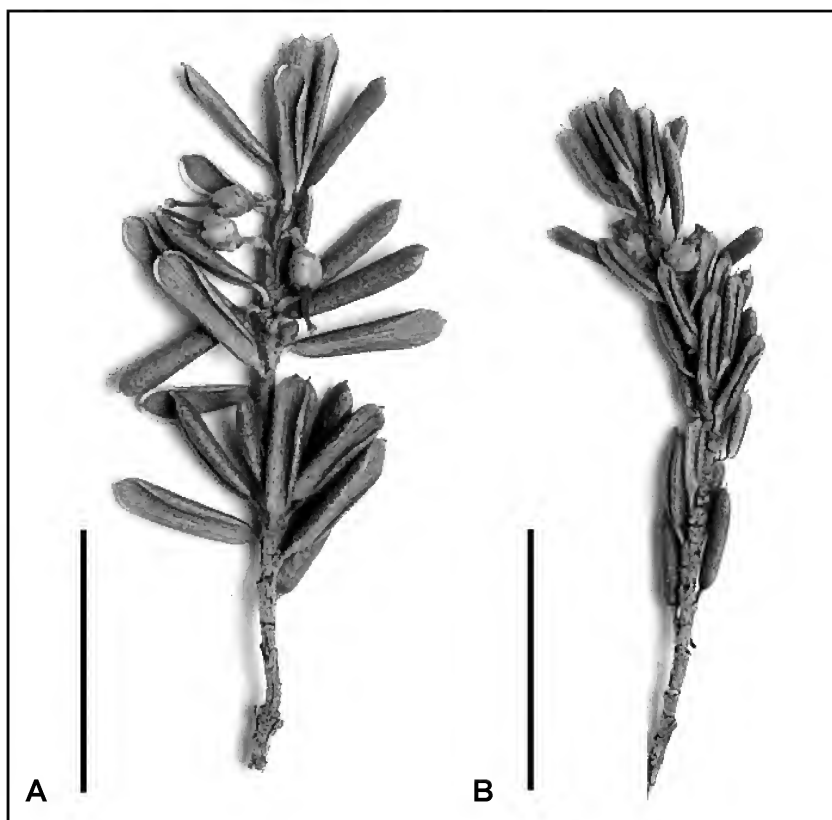


Figure 4. Photographs of post-flowering branchlets of *Brachyloma elusum* and *B. nguba* with corollas shed, giving a comparison of leaf character, peduncle and style length. A – *B. elusum*, from M. Hislop 4595; B – *B. nguba*, from L. Silvester & R. Buehrig s.n. Scale bar = 1 cm.

*Etymology.* *Elusus* is past participle of the Latin verb *eludo* (avoid, evade), a reference to elusive nature of this species and the difficulty to date, of finding new populations.

*Conservation status.* To be listed as Priority Two under Conservation Codes for Western Australian Flora (M. Smith pers. comm.). Currently known from two populations, about 80 km apart, one from a water reserve and the other in a nature reserve. At the northern locality only a single plant was noted at the time of collection. The population east of Hyden occurs in a nature reserve and consists of at least several dozen plants scattered over a wide area. There are significant tracts of uncleared vegetation remaining in this general area, including a number of reserves, and so the chances of finding new populations still appear good.

*Affinities.* In its stamen character, short sepals and recurved leaf margins *B. elusum* is most similar to *B. nguba* Cranfield. At the northern edge of its range the latter species is known to occur only about 30 km to the east of the Hyden population of *B. elusum*. As indicated in the key, there are several significant differences between them and the two should not be confused, at least under magnification. In the field they are distinguishable on the basis of the noticeably wider leaves of *B. elusum* (1.0–2.0 mm vs 0.5–1.2 mm but usually less than 1 mm in *B. nguba*) and longer inflorescence axis of *B. elusum* (0.9–1.8 mm long vs 0.5–0.7 mm).

**Brachyloma pirara** Cranfield & Hislop, *sp. nov.*

*Typus*: north-east of Northampton, Western Australia [precise locality withheld for conservation reasons], 7 June 2005, *M. Hislop* 3448 (*holo*: PERTH 07011539; *iso*: CANB, MEL, NSW).

*Brachyloma pirara* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma* sp. Kalbarri (A.H. Burbidge 4505), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017]

Erect, compact *shrubs* to c. 60 cm high and 60 cm wide, multi-stemmed from the base of plant, but probably with a fire-sensitive rootstock. Young *branchlets* with a moderately dense to dense indumentum of variously orientated hairs of mixed lengths, 0.1–0.7 mm long. *Leaves* variously orientated from shallowly retrorse to steeply antrorse; apex long-mucronate, pungent, the mucro 0.5–1.0 mm long; base cuneate or sometimes rounded; petiole well-defined, 0.4–0.8 mm long, usually sparsely hairy at least on the adaxial surface; lamina narrowly obovate to narrowly elliptic (occasionally narrowly ovate), 5.0–8.0 mm long, 1.2–2.2 mm wide, curvature varying from slightly concave adaxially to slightly convex, longitudinal axis  $\pm$  straight; surfaces glaucous, markedly discolorous, glabrous or sparsely scabrous with short, coarse hairs on either surface; adaxial surface becoming shiny through abrasion, venation not evident; abaxial surface paler, with 5–7 primary veins, flat between the veins; margins coarsely ciliate with hairs 0.08–0.20 mm long. *Inflorescence* erect, axillary; axis 0.7–1.2 mm long, 1-flowered, glabrous or sparsely hairy, terminating in the flower, bud-like rudiment absent. *Fertile bracts* very variable in size, broadly ovate to depressed-ovate, 0.3–1.2 mm long, 0.3–1.0 mm wide, subtended by 7–11 sterile bracts. *Bracteoles* broadly ovate to depressed-ovate, 1.8–2.8 mm long, 1.7–2.5 mm wide, obtuse; abaxial surface glabrous,  $\pm$  striate; margins ciliolate. *Sepals* broadly ovate to ovate, 3.0–3.6 mm long, 2.0–2.7 mm wide, obtuse; abaxial surface glabrous, greenish or straw-coloured, becoming red towards margins,  $\pm$  striate with 7–9 slightly raised veins; adaxial surface glabrous; margins ciliolate with hairs 0.02–0.05 mm long. *Corolla tube* red, obovoid or narrowly obovoid, exceeding the sepals, 3.6–4.6 mm long, 2.4–3.0 mm wide, glabrous externally, internal surface glabrous apart from 5 reflexed, hairy appendages inserted at the apex; appendages 2.0–2.8 mm long, 0.5–0.7 mm wide, with hairs 0.3–0.7 mm long on the margins and distal surfaces. *Corolla lobes* red, ovate or narrowly ovate, shorter than the tube, 2.6–3.5 mm long, 1.8–2.4 mm wide, imbricate basally, acute or subacute, flat adaxially, erect basally, recurved in the upper half, with margins often sparsely and irregularly ciliolate, glabrous externally, internal surface minutely papillose. *Anthers* yellow, partially exserted from the tube (by 1/8–1/4 of their length), 1.5–2.0 mm long, the lateral surfaces papillose, apex shallowly emarginate. *Filaments* very short and broad-based, the free portion to c. 0.3 mm long, attached c. 3/4 above anther base. *Nectary* annular, 0.35–0.55 mm long, with a jagged rim. *Ovary* ovoid, 1.2–1.5 mm long, 1.0–1.2 mm wide, glabrous, 3–5-locular (mostly 4-). *Style* 0.35–0.55 mm long, tapering smoothly from ovary apex and poorly differentiated at flowering, included within the corolla tube; stigma not expanded. *Fruit* much longer than calyx, globose to broadly ellipsoid, 5.0–6.0 mm long, 5.0–5.5 mm wide, glabrous; surface faintly rugose; style persistent. (Figures 2C, 5)

*Diagnostic characters.* Distinguished from all other members of the genus by the following character combination: relatively long and conspicuous branchlet indumentum 0.1–0.7 mm long; leaf margins conspicuously ciliate with coarse hairs 0.08–0.20 mm long; sepals shorter than the corolla tube; anthers partially exserted from the corolla tube; filaments very short and broad-based or  $\pm$  obsolete; style poorly differentiated from ovary apex, 0.35–0.55 mm long; fruit globose to broadly ellipsoid.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 9 Sep. 1990, *A.H. Burbidge* 4505 (PERTH); 17 July 1966, *A.C. Burns* 4 (PERTH); 18 Aug. 1974, *A.C. Burns* 16 (PERTH); 18 Aug. 1994, *R.J. Cranfield* 9332 (PERTH); 24 June 1997, *R. Davis* 3520 (PERTH); 15 May 1968, *H. Demarz* D73 (PERTH); 13 June 1976, *A.S. George* 14273 (PERTH); 13 May 1968, *P.G. Wilson* 6747 (CANB, PERTH).

*Distribution and habitat.* Occurs between Whicherina, East Binu and Kalbarri National Park in the Geraldton Hills sub-region of the Geraldton Sandplains bioregion (Figure 3). *Brachyloma pirara* is apparently restricted to yellow sandplains in low woodland or heath.

*Phenology.* Apparently very similar to *B. djerral*, with peak flowering between late autumn and mid-winter. Like that species it also appears to flower sporadically outside this period, probably depending on the pattern of recent local rainfall.

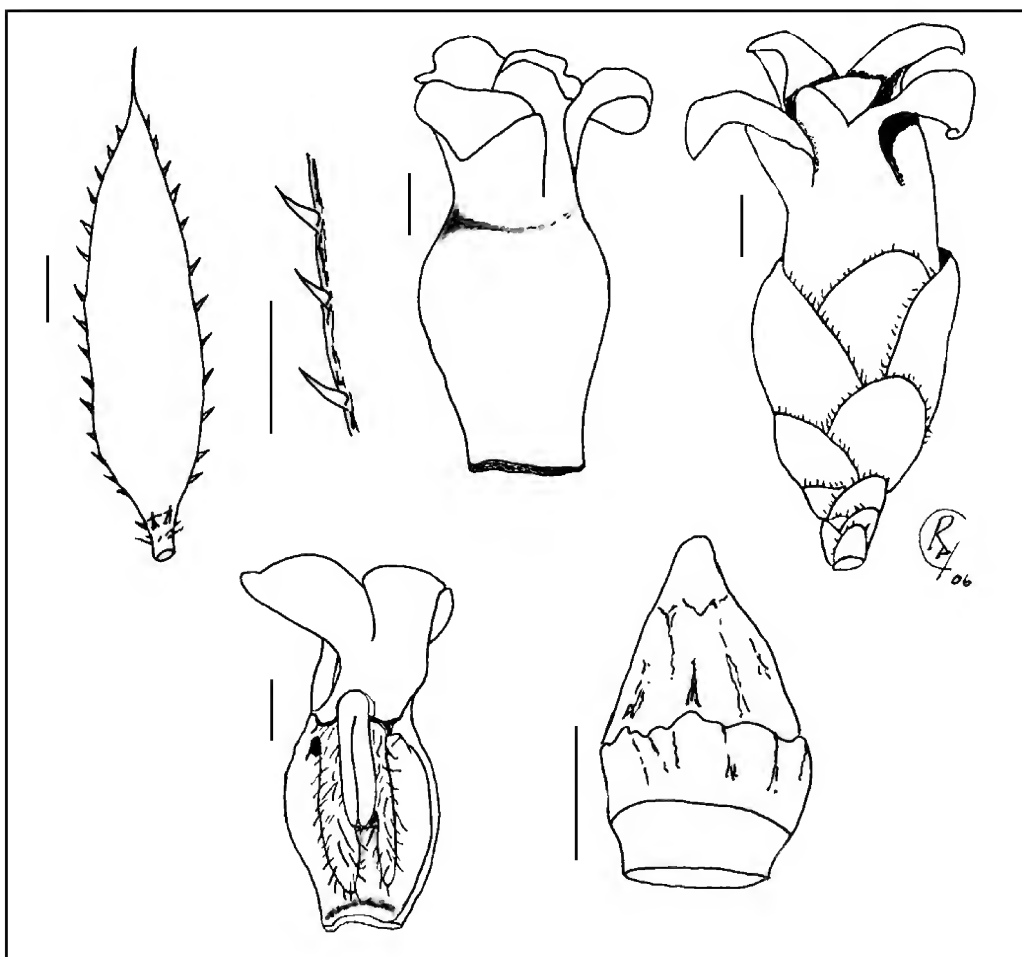


Figure 5. *Brachyloma pirara*. A – leaf; B – detail of leaf margin; C – corolla, external view; D – flower, including bracts, bracteoles and sepals; E – internal corolla tube, part of upper portion showing one anther and two reflexed appendages; F – gynoecium. Scale bars = 1 mm. Drawn by Ray Cranfield from *M. Hislop* 3448.

*Etymology.* From the Noongar language of the traditional inhabitants of the area, *pirara*, sand or sandy place (Bindon & Chadwick 1992), referring to the soil preference of this species.

*Conservation status.* Listed under its manuscript name as Priority Two under Conservation Codes for Western Australian Flora (Smith 2017). This species is poorly known, with just nine collections at PERTH, and only two of them made in the last 20 years. Within the conservation estate it has been recorded from the north-eastern part of Kalbarri National Park, south of Eurardy Reserve.

*Affinities.* *Brachyloma pirara* is one of two members of the genus that occur north of Geraldton and, according to recently published molecular data (Puente-Lelièvre *et al.* 2016), its closest relative is the other species from that area, *B. djerral*. The two are readily distinguished however, and the differences between them are discussed under the affinities heading for *B. djerral*.

The only other occurrence of the genus in the Geraldton Sandplains bioregion is from south of Geraldton where one or possibly two taxa from the *B. preissii*–*B. geissoloma* complex are distributed as far north as the Eneabba–Three Springs area. These can be readily separated from the two northern species by their short, innocuous leaf apices (*cf.* long-mucronate and pungent) and in having anthers that are fully exserted from the corolla tubes on long, fleshy filaments (*cf.* partially included on very short filaments in *B. pirara* and *B. djerral*).

### **A new combination, a lectotypification, and the synonymisation of eight manuscript names**

***Brachyloma geissoloma*** (F.Muell.) Cranfield, *comb. nov.*

*Stenanthera brachyloma* F.Muell., *Fragm.* 4(27): 99 (1864). *Cyathodes brachyloma* F.Muell., *Fragm.* 4(27): 99 (1864), *nom. inval.* *Styphelia geissoloma* F.Muell., *Fragm.* 6(42): 39 (1867). *Brachyloma concolor* F.Muell., *Fragm.* 6(42): 39 (1867), *nom. inval.* *Brachyloma concolor* F.Muell. ex Benth., *Fl. Austral.* 4: 172 (1868), *nom. illeg.* *Type:* ‘ad extremitatum occidentalem sinus Great Bight’ [south coast of Western Australia, east of Esperance], *G. Maxwell s.n.* (*syn:* MEL 2079293!, MEL 2079294!).

*Brachyloma geissoloma* subsp. *collinum* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma geissoloma* subsp. *ovatum* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma ericoides* subsp. *occidentale* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma moolya* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Notes.* This species was first published by Mueller (1864) as *Stenanthera brachyloma* F.Muell., at which time the author also listed the superfluous name *Cyathodes brachyloma* F.Muell. in synonymy. Later, still reluctant to use Sonder’s (1845) new generic name, Mueller (1867) described the species a second time as *Styphelia geissoloma* F.Muell., based on the same Maxwell type. On this occasion he added another superfluous name, *Brachyloma concolor* F.Muell., and included his earlier name, *Stenanthera brachyloma*, as a synonym. Bentham (1868) accepted *Brachyloma* as a good genus but

erred in taking up *B. concolor* as a valid name. The first published species epithet, *brachyloma*, is a tautonym and therefore cannot be used, leaving *geissoloma* as the next validly published name.

***Brachyloma preissii*** Sond. in Lehm., *Pl. Preiss.* 1(2): 304 (1845). *Styphelia brachyloma* F.Muell., *Fragm.* 6(42): 39 (1867). *Type*: ‘In arenosis prope Bull’s-creek’ [Bull Creek, suburban Perth, Western Australia], November 1841, *J.A.L. Preiss s.n.* (*lecto*, here designated: MEL 0624586!); ‘Swan River’ [Western Australia], 1843, *J. Drummond* 480 (*syn*: MEL 0624587!, K 000356350 image seen, P 00760487 image seen).

*Brachyloma preissii* var. *brevifolium* Sond. in Lehm., *Pl. Preiss.* 1(2): 305 (1845). In regionibus interioribus Australiae meridionali-occidentalis [between York and Albany, Western Australia], October 1840, *L. Preiss* 426 (*syn*: MEL 0624588).

*Brachyloma preissii* subsp. *lanceolatum* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma preissii* subsp. *obtusifolium* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma jillup* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Brachyloma tamminense* Cranfield ms, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 7 July 2017].

*Lectotypification.* The Preiss collection from Sonder’s own herbarium, now at MEL, is here selected as lectotype. It was collected from what is today suburban Perth. It has the relatively large, convex leaves (*c.* 12–16 mm long and 2–3 mm wide) with short mucros (to *c.* 0.4 mm long) that are typical of the species on the Swan Coastal Plain, north and south of Perth.

The second collection cited by Sonder in his protologue, *Drummond* 480, has some unusual features for the species. The combination of long (*c.* 1 mm), very fine mucros and long (*c.* 4 mm) peduncles is seen in only a couple of specimens at PERTH, from the Darling Range north-east of Perth (e.g. *G.J. Keighery* 3963 from Clackline). Whether this morphotype should be regarded as conspecific with the form lectotypified here is a question that will need to be addressed when the taxonomy of the *B. preissii*–*geissoloma* complex is revisited.

### Acknowledgements

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## SHORT COMMUNICATION

**Reinstatement of *Hypocalymma linifolium* and lectotypification of *H. xanthopetalum* (Myrtaceae: Chamelaucieae)**

*Hypocalymma* (Endl.) Endl. is a south-western Australian genus of Myrtaceae tribe Chamelaucieae DC. that comprises at least 30 species. The genus was reviewed by Strid and Keighery (2002), who selected lectotypes for a number of species including *H. xanthopetalum* F. Muell. However, their lectotypification of *H. xanthopetalum* was incomplete as they did not specify which of the two syntypes represented at MEL they were designating. An Oldfield collection from Yatheroo is chosen here as the lectotype.

This short communication also reinstates *H. linifolium* Turcz., which was treated by Strid and Keighery (2002) as a synonym of *H. tetrapterum* Turcz., and seeks to clarify which Drummond specimens are part of the type gathering. Some of the major differences between the three species examined here are given in the key below.

1. Young stems ± terete (not obviously angled), hairy. Stamens commonly 50–115. Ovules 2 per locus (Mingenew–Muehea) ..... **H. xanthopetalum complex**
- 1: Young stems 4-angled, glabrous. Stamens commonly 20–40. Ovules 1 per locus
2. Petals 2.5–3 mm long, bright yellow. Style 3–3.5 mm long; base terminal on ovary (Badgingarra–Dandaragan area) ..... **H. linifolium**
- 2: Petals 3–4 mm long, white or pink. Style 4–5 mm long; base inserted in a depression that reaches down to the level of the placentas (Eneabba–S of Badgingarra) ..... **H. tetrapterum**

***Hypocalymma linifolium* Turcz., Bull. Soc. Imp. Naturalistes Moscou 35(2): 325 (1862). Type citation:** ‘Cum prioribus sub. n. 65.’ **Type specimen:** Swan River [between Dandaragan and lower Murchison River, Western Australia, 1850–1851], *J. Drummond* 6: 65 [as 7: 65] (*holo*: KW 001001303; *iso*: BM 001015085, E 00394754, G 00223369, ?K 000821997, LD 1034286 & 1035774, MEL 0104602 [pieces on left enclosed with tag bearing the number 65], NSW 456458, W 18890153069).

*Shrub* commonly 0.5–0.7 m high, probably with a lignotuber; flowering stems commonly with 3–5 clusters of flowers. *Young stems* 4-angled, glabrous, each angle with an obvious ridge at first. *Leaves* sessile, narrowly ovate to almost linear, 12–14 mm long, 2–4 mm wide, concolorous, glabrous, with entire margins, with an obvious groove along the midrib of abaxial surface and often also with a very narrow groove along the midvein of the abaxial surface; apex acute, mucronulate. *Peduncles* very reduced; basal bract persistent, 1–2 mm long. *Bracteoles* persistent, 1.5–2 mm long. *Pedicels* ± absent. *Flowers* 6–8 mm diam. *Hypanthium* 1.25–1.5 mm long, c. 3 mm diam. *Sepals* 1.3–1.6 mm long, scarious, minutely and irregularly denticulate to entire. *Petals* 2.5–3 mm long, bright yellow, persistent. *Stamens* 22–41, in 2 series, very shortly united at base. *Longest filaments* c. 3 mm long. *Anthers* c. 0.5 mm long. *Ovary* 3-locular; ovules 1 per locus, erect. *Style* 3–3.5 mm long; base not inset. *Fruits* 2.5–3 mm long. *Seeds* not seen at maturity but at least 2.1 mm long, reticulate-pitted, brown with a whitish inner protrusion.

*Diagnostic features.* Young stems 4-angled, glabrous. Leaves 12–14 mm long, 2–4 mm wide, entire. Petals 2.5–3 mm long, bright yellow, persistent. Stamens 22–41. Ovary 3-locular; ovules 1 per loculus. Style 3–3.5 mm long; base not inset.

*Specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 27 Sep. 1932, W.E. Blackall 2903 (PERTH); 23 Aug. 1968, K.R. Newbey 2784 (PERTH).

*Distribution and habitat.* Occurs in sand in the Dandaragan area.

*Phenology.* Flowers from August to September.

*Etymology.* From the Latin *linum* (thread) and *-folius* (-leaved) in reference to the narrow leaves of this taxon. However, narrower, more thread-like leaves are found in *H. gardneri* Strid & Keighery, which is part of the *H. xanthopetalum* complex.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority One (Smith 2017). The most recent collection of this taxon was made in 1968 so it is in urgent need of a field survey to determine how many populations, if any, still exist.

*Typification.* In publications before 1 January 2001, if the author cited a particular specimen as the holotype ‘of a previously published name but other specimens of the cited gathering existed, then under ICN Art. 9.9 this was an error to be corrected to lectotype’ (McNeill 2014: 1112). It can therefore be argued that Marchant (1990) has effectively lectotypified many Turczaninow names, including *H. linifolium*, by citing them as holotypes. Strid and Keighery (2002) refer to the KW sheet of *H. linifolium* as the lectotype but do not attribute the lectotypification to Marchant (1990) nor do they include the words ‘here designated’. I regard KW 001001303 as the holotype since it was the only specimen used by the author.

MEL 0104602 and MEL 0104603 are labelled as having material collected by James Drummond, with the collection number given as 65. However, all of the pieces on MEL 0104603 and three pieces on MEL 0104602 do not match the protologue of *H. linifolium* as they have hairy stems. The material with glabrous stems on the left side of MEL 0104602, to which the tag number 65 is affixed, is interpreted as type material of *H. linifolium*. The remaining three pieces on this sheet are referable to *H. xanthopetalum*, while material on MEL 0104603 is entirely of *H. xanthopetalum*, with some material on the latter sheet having particularly narrow leaves. The three pieces of *H. xanthopetalum* on MEL 0104602 are variable, with the specimen on the left having fairly narrow leaves with a hairy undersurface and the two on the right having broad leaves with both surfaces glabrous. There is a possibility that some of the material of *H. xanthopetalum* on these two sheets corresponds to either *J. Drummond* 66 or 67 (the type numbers of two synonyms, *H. ciliatum* Turcz. and *H. cuneatum* Turcz.; see below) but I cannot confidently assign this material to either collection. Confusion of the collecting numbers may also have occurred on K 000821997, which is labelled *J. Drummond* 66 (the type of *H. ciliatum*) but has been determined by Arne Strid as type material of *H. linifolium*.

*Affinities.* Turczaninow (1862) placed *H. linifolium* in sect. *Chrysocalymna* Turcz. *nom. illeg.* together with two other yellow-flowered taxa that are now considered to be synonyms of *H. xanthopetalum*. He recorded the ovule number of all these taxa as two per loculus, but that was incorrect as *H. linifolium* differs from the *H. xanthopetalum* complex in having only one ovule per loculus. Bentham (1867) corrected that error in ovule number, and transferred *H. linifolium* to sect. *Astrocalymma* Schauer, where *H. tetrapterum* was placed. He distinguished *H. linifolium* from *H. tetrapterum* by differences

in its leaves and flower colour. Note that both sect. *Chrysocalymma* and sect. *Astrocalymma* are now treated as synonyms of sect. *Hypocalymma* (Rye *et al.* 2013).

*Hypocalymma linifolium* was reduced to synonymy under *H. tetrapterum* by Strid and Keighery (2002: 557), who considered it to be a 'slender, more narrow-leaved form collected in the same area as the type of *H. tetrapterum*'. While *H. tetrapterum* does appear to be a close relative, it differs from *H. linifolium* in the characters used in the key above, as well as its tendency to have somewhat winged young stems and more obvious oil glands. In *H. tetrapterum* the leaves usually have numerous oil glands that are surrounded by a circle of papillae, and the young stems may have a papillose appearance through the dense cover of similar oil glands.

*Notes.* The identity of *H. linifolium* has been confused for some time, perhaps partly as a result of the uncertainty regarding its ovule number and the mixed material on MEL 0104602 and 0104603, although the species keys out accurately in Blackall and Grieve (1980). A number of taxa, including one in cultivation (Elliot & Jones 1990), have been misidentified as *H. linifolium*.

Of the two PERTH collections currently housed as *H. linifolium*, K.R. Newbey 2784 matches the type best in having a narrow groove along the midvein of the upper surface of many of its leaves, whereas W.E. Blackall 2903, which was possibly collected further west, has the upper surface level along the midvein of all leaves. The immature seeds examined were from the latter collection.

Drummond (1853) discussed a number of *Hypocalymma* species he collected in the region north of Perth, including the Dandaragan area, so clearly travelled through the small area where *H. linifolium* was collected in 1932 and 1968. The rarity of the taxon raises the possibility that it is a hybrid, presumably between *H. tetrapterum* and one of the members of the *H. xanthopetalum* complex. However, in view of its persistence from its original collection in about 1850 up to the last known sighting of 1968 and its clearly distinctive morphology, the taxon certainly appears to warrant formal recognition.

**Hypocalymma xanthopetalum** F.Muell., *Fragm.* 2: 29 (1860). *Type citation*: 'In locis aridis ad sinum Champion Bay et flumen Murchison. A. Oldfield.' *Type specimens*: near Yatheroo [south of Dandaragan], Western Australia, 1859–1860, A.F. Oldfield 33 (*lecto*, here designated: MEL 0104657); 'Champion Bay' [probably collected south of Dongara, Western Australia], *s. dat.*, no collector or number specified [presumably A.F. Oldfield] (*residual syn*: MEL 0104658).

*Hypocalymma ciliatum* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 35(2): 325 (1862). *Type citation*: 'Cum prioribus sub. n. 66.' *Type specimen*: Swan River [between Moore and Murchison Rivers, Western Australia], 1850–1851, J. Drummond 6: 67 [as 7: 67] (*holo*: KW 001001301; *iso*: BM 001015083, G 00223371, K 000821986, LD 1005390 & 1005454, MEL 104659, W).

*Hypocalymma cuneatum* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 35(2): 325 (1862). *Type citation*: 'Cum prioribus sub. n. 67.' *Type specimen*: Swan River [between Moore and Murchison Rivers, Western Australia], 1850–1851, J. Drummond 6: 67 [as 7: 67] (*holo*: KW 001001302; *iso*: BM 001015082, G 00223372, K 000821985).

*Typification.* Both syntypes of *H. xanthopetalum* are a good match for the protologue, although the material is poor, with the stems largely bare and the leaves and flowers mostly contained in packets. The leaves are larger on average on MEL 0104658 than on MEL 0104657, being up to 8 mm wide on the former and up to 6 mm wide on the latter. Both specimens have blue labels with 'Hypocalymma

xanthopetala' in Mueller's handwriting and were seen by Bentham. Neither sheet is annotated by Arne Strid or Greg Keighery.

Both of the localities given in the protologue, Champion Bay and Murchison River, are north of the known distribution of *H. xanthopetalum*, which extends from Mingenew south to Muchea. MEL 0104657 has an Oldfield label that reads 'Diffuse shrub 1 foot. – sandy Place near Yatheroo. 33', and a separate blue Mueller label that gives the locality as 'Murchison R., W.A.' and indicates Oldfield as the collector. Yatheroo is certainly a likely place for the specimen to have been collected, well within the current distribution of *H. xanthopetalum*. MEL 0104658 has no collection information other than a locality of 'Champion Bay'. It seems likely that this specimen was also collected by Oldfield, although the collection was presumably made at least 60 km further south. MEL 104658 is selected here as the lectotype because it bears the collector's notes and an accurate locality.

*Notes.* Specimens currently placed under *H. xanthopetalum* are extremely variable, with the narrowest-leaved ones apparently intergrading with specimens currently identified as *H. gardneri*. The *H. xanthopetalum* complex needs detailed study to determine how many species should be recognised; many characters, such as stamen number and the degree to which the filaments are connate, appear to show continuous variation, rather than having clear discontinuities that could be used to delimit taxa.

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## A revision of the *Calytrix acutifolia* complex (Myrtaceae: Chamelaucieae)

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### Abstract

Nge, F.J., Keighery, G.J. & Thiele, K.R. A revision of the *Calytrix acutifolia* complex (Myrtaceae: Chamelaucieae). *Nuytsia* 28: 321–337 (2017). In this taxonomic review of the *Calytrix acutifolia* (Lindl.) Craven species complex we recognise four species, one of which (*C. retrorsifolia* Nge & Keighery) is described as new. *Lhotskya hirta* Regel is recombined into *Calytrix* Labill. as *C. hirta* (Regel) Nge & K.R.Thiele, while *L. scabra* Turcz. is recombined as *C. cravenii* Nge & K.R.Thiele. *Calytrix acutifolia* s. str. is recircumscribed as the fourth member of the complex.

### Introduction

*Calytrix* Labill. is an endemic Australian genus comprising c. 90 species distributed throughout Australia, with centres of species richness in northern and south-western Australia (Craven 1987). The most recent revision of the genus was completed by Craven (1987), following which nine new species have been described and named by various authors (Craven 1990, 1991; Keighery 2004; Barrett *et al.* 2009; Rye 2013). Six informal phrase-named taxa belonging to two species complexes within the genus are currently recognised in Western Australia (Western Australian Herbarium 1998–); four of these are assigned to the *C. acutifolia* (Lindl.) Craven species complex (Rye 2013).

*Calytrix acutifolia* was described (as *Lhotskya acutifolia* Lindl.) in 1839, with no type cited. Craven (1987) followed Mueller (1859) and Court (1957) in regarding *Calytrix* and *Lhotskya* Schauer as congeneric, formally transferring all species of the latter into the former. He reduced three species of *Lhotskya* (*L. ericoides* Schauer, *L. scabra* Turcz. and *L. hirta* Regel) to synonyms of *C. acutifolia*, recognising it as a single, variable and wide-ranging species distributed from the Arrowsmith River southward to Albany and east to Cape Arid. He placed *C. acutifolia* provisionally in a small informal group of five species (the ‘*C. violacea* (Lindl.) Craven group’, characterised by 2–4-seriate stamens and a hypanthium not produced above the ovary), but regarded it as anomalous within that group on account of some features shared with the eastern Australian *C. glaberrima* (F.Muell.) Craven and the widespread *C. tetragona* Labill. in the *C. tetragona* group (characterised by a 1-seriate androecium). None of Craven’s species groups were formally named, and relationships of species within *Calytrix* have not been tested in an explicitly phylogenetic framework.

Preliminary assessment of field and herbarium specimens by one of us (GK) in 2001 led to the segregation from *C. acutifolia* of four informal, phrase-named taxa: *C. sp. Eneabba* (B.J. Lepschi & T.R. Lally BJL3617), *C. sp. Scarp* (H. Bowler 270), *C. sp. Tutunup* (G.J. Keighery & N. Gibson 2953) and *C. sp. Wheatbelt* (R. Davis 4544) (Western Australian Herbarium 1998–). At that time, *C. acutifolia s. str.* was regarded as comprising specimens from the south coast of Western Australia between Cape Naturaliste and Bremer Bay, inland to the Stirling Range. A re-examination of type specimens by B. Rye (pers. comm.) subsequently led to the recognition that *C. sp. Scarp* represents *C. acutifolia s. str.*, with specimens previously assigned to *C. acutifolia* placed under the informal name *C. sp. Esperance* (M.A. Burgman 4268A).

*Calytrix sp. Esperance* was further separated in the collection at the Western Australian Herbarium (PERTH), though without formal phrase-naming, into an eastern and western morphotype (east and west of Bremer Bay respectively) by one of us (GK) based on differences in leaf dimensions, the western form having longer and narrower leaves than the eastern form. Within *C. sp. Wheatbelt*, a group of collections from near Calingiri with unusually short leaves was tentatively segregated (by GK) from *C. sp. Wheatbelt*, but was not recognised as distinct by Rye (2013).

The present paper is the result of a detailed examination of all specimens in the *C. acutifolia* species complex held at PERTH, of images of relevant type specimens available through *Global Plants* (<https://plants.jstor.org>), and of type material held at KW, to ascertain taxon boundaries within the complex.

## Methods

Preliminary assessment of herbarium material confirmed that there is considerable variation in leaf dimensions among taxa within the *C. acutifolia* complex, particularly between the eastern and western forms of *C. sp. Esperance*, and within *C. sp. Wheatbelt* and *C. sp. Eneabba*. To assess this variation quantitatively, lengths and widths of leaves were measured, and length:width ratios calculated, from representative herbarium specimens across all taxa within the complex. Three mature leaves per specimen were measured with a digital caliper to the nearest 0.01 mm; average values were then calculated for each measured specimen.

To assess the influence of climate on variations in leaf dimensions across the distributional ranges of members within the complex, locations of specimens examined were uploaded into the Spatial Portal of the Atlas of Living Australia (ALA; <http://www.ala.org.au>), and mean annual aridity index (AI) values retrieved. Correlations between AI and leaf dimensions were assessed using the R statistics package (R Core Team 2016).

The distribution map is based on PERTH specimens only, and shows the *Interim Biogeographic Regionalisation for Australia* (IBRA) v. 7 bioregions (Department of the Environment 2013).

## Results and Discussion

Detailed assessment of floral and vegetative characters revealed consistent differences between some but not all putative taxa in the *C. acutifolia* complex. Four morphologically discrete forms were readily separable (Table 1). Characters that are taxonomically useful include hypanthium morphology, bracteole (cheridium) shape, calyx and corolla size, leaf arrangement, indumentum, shape in transverse section (TS), and apex shape.

A combination of these characters adequately discriminates *C. acutifolia*, *C. sp. Esperance* and *C. sp. Tutunup*. Several characters distinguish *C. sp. Eneabba* and *C. sp. Wheatbelt* from the other members within the complex; however, no consistent differences were found to separate these two from each other.

**Table 1.** Morphological comparison of taxa in the *Calytrix acutifolia* species complex.

Character	<i>C. acutifolia</i>	<i>C. sp. Esperance</i>	<i>C. sp. Tutunup</i>	<i>C. sp. Wheatbelt</i>	<i>C. sp. Eneabba</i>
<b>Indumentum</b>	present on stems only (leaves, hypanthium and bracteoles glabrous)	present on stems, leaves, hypanthium and bracteoles	present on stems, leaves and bracteoles (hypanthium glabrous)	present on stems, leaves, hypanthium and bracteoles	present on stems, leaves, hypanthium and bracteoles
<b>Stem hair length (mm)</b>	0.05–2	0.1–0.5	0.1–0.5	0.05–0.15(–0.2)	0.05–0.15(–0.2)
<b>Leaf hair length (mm)</b>	absent	≤ 0.05	≤ 0.05	0.05–0.2	0.05–0.2
<b>Leaf arrangement on stems</b>	usually antrorse, rarely patent at maturity	mostly patent at maturity	reflexed at maturity	mostly antrorse at maturity (leaves appressed in the Calingiri form)	mostly antrorse at maturity
<b>Leaf length (mm)</b>	8.6–12.6	3–11	3.7–7.3	2.7–9.2	4–10.5
<b>Leaf length:width ratio</b>	7.4–26.3	5–28.5	7.7–17.8	5.1–21.0	8.7–14.2
<b>Leaf transverse section</b>	depressed-triangular with concave adaxial surface	depressed-angular-obovate	depressed-angular-obovate	depressed-triangular	depressed-triangular
<b>Protruding midrib on abaxial surface</b>	present	absent	absent	absent	absent
<b>Translucent wings on bracteoles (cheridium)</b>	broad and overlapping to apex, covering > 3/4 of the hypanthium	reduced, scarcely overlapping (hypanthium clearly visible)	reduced, scarcely overlapping (hypanthium clearly visible)	reduced, with hypanthium clearly visible to wings that extend and overlap to the mid-point, covering c. 1/2 of the hypanthium	reduced, with hypanthium clearly visible to wings that extend and overlap to the mid-point, covering c. 1/2 of the hypanthium
<b>Hypanthium</b>	5–7-ribbed, smooth between the ribs	mostly 6–8-ribbed, smooth or rarely rugose between the ribs	5-ribbed, prominently rugose between the ribs	5-ribbed, smooth or rugose-pitted between the ribs	5-ribbed, smooth between the ribs
<b>Hypanthium length (mm)</b>	3.5–4.5	(2–)2.5–3.5	1.5–2	1.7–4	2.5–4
<b>Petal length (mm)</b>	7.5–10	4–5.5(–7)	4–5	4–7	6–7
<b>Petal width (mm)</b>	2–2.5	0.8–1.5	0.5–1.3	1.5–1.7	1.5–1.7
<b>Number of stamens</b>	40–85	32–46	23–40	18–50	18–50

Leaf dimensions (length, width, length:width ratio) within the complex overlap significantly, and were not found to be taxonomically useful, except that *C. acutifolia* has longer and wider leaves than other members within the complex (Figure 1). Within *C. sp. Esperance*, the eastern morphotype has shorter and wider leaves than the western variant (Figure 1). Patterns of variation in leaf length and width in *C. sp. Esperance* are geographically correlated (Figure 2); specimens that are geographically intermediate between the two morphotypes have leaves that are intermediate in leaf dimensions. Leaves in general are shortest and widest at the easternmost end of its distribution, and longest and narrowest at the westernmost end, with the exception of plants from near Cape Leeuwin that have shorter and

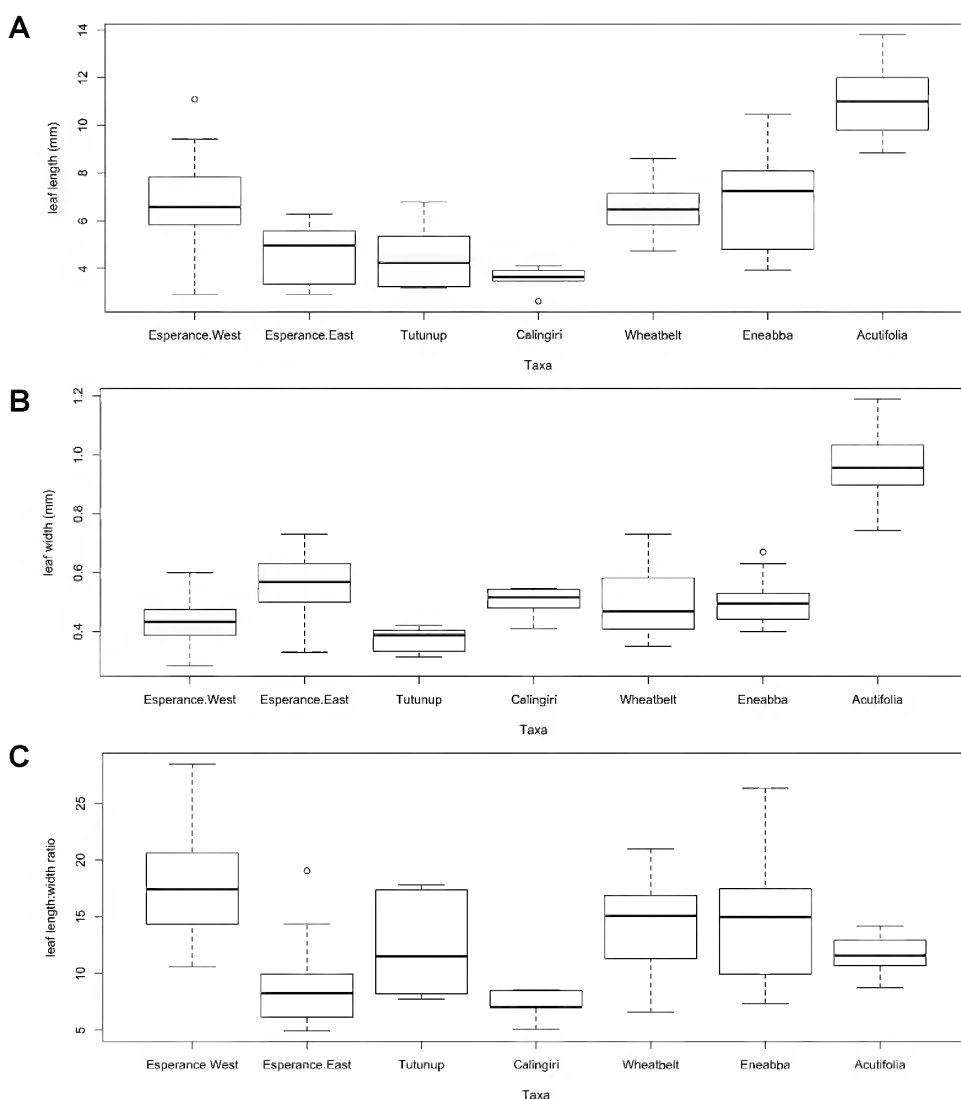


Figure 1. Variation in leaf morphology of members within the *Calytrix acutifolia* complex based on herbarium specimens examined in PERTH. A – leaf length (mm); B – leaf width (mm); C – leaf length:width ratio. Rectangles define 25 and 75 percentiles; horizontal lines show median; whiskers are from 10 to 90 percentiles; circles indicate outliers. Taxon names ‘Esperance.West’ and ‘Esperance.East’ refer to the two respective variants of *C. sp. Esperance* (M.A. Burgman 4268A), and ‘Calingiri’ refers to the Calingiri form of *C. sp. Wheatbelt* (R. Davis 4544).

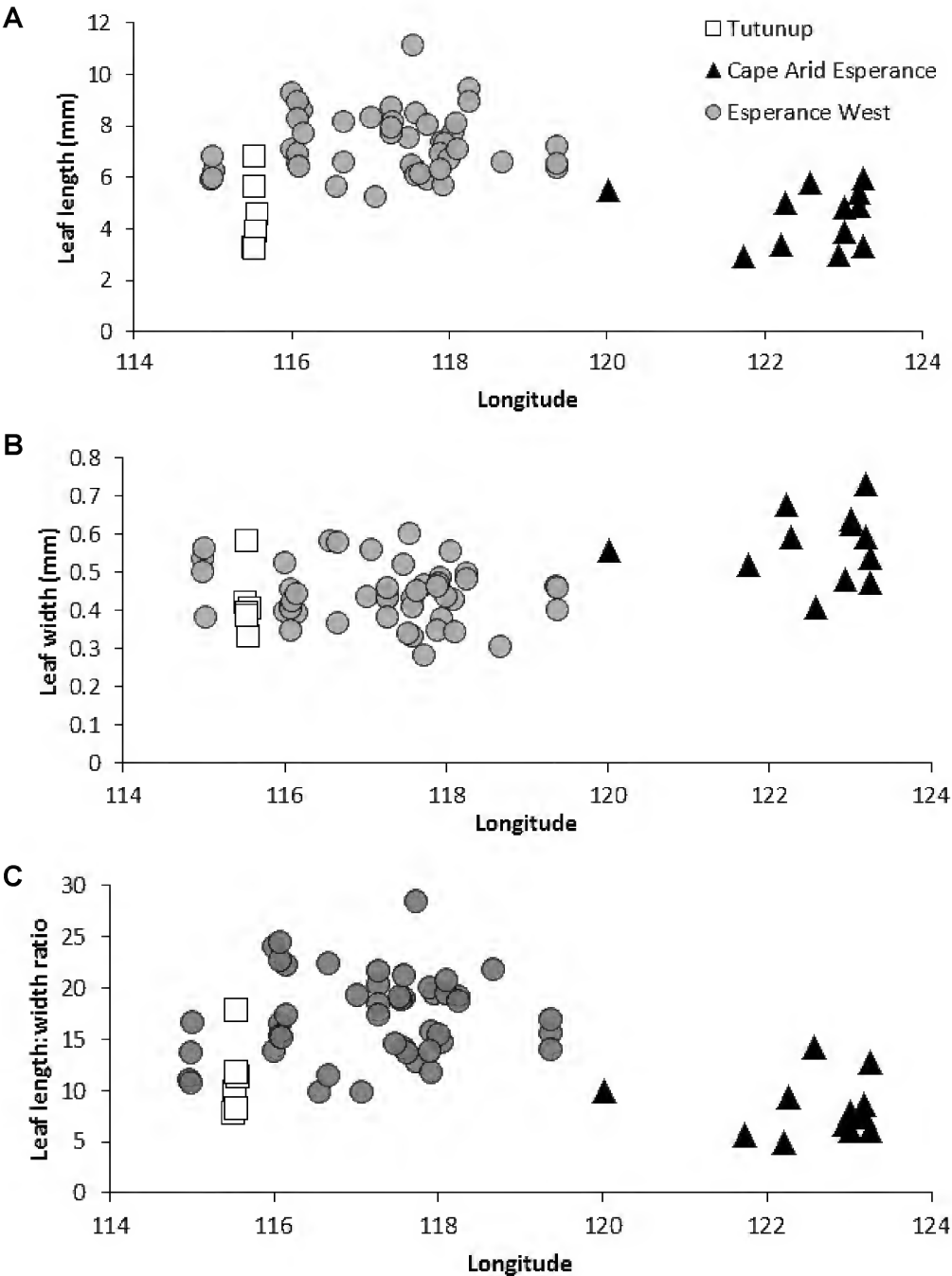


Figure 2. Variation in leaf morphology of *Calytrix* sp. Esperance (M.A. Burgman 4268A) and *C.* sp. Tutunup (G.J. Keighery & N. Gibson 2953) against geographic locality (as longitude) of specimens examined in PERTH. A – leaf length (mm); B – leaf width (mm); C – leaf length:width ratio. Taxon names ‘Cape Arid Esperance’ and ‘Esperance West’ refer to the two respective variants of *C.* sp. Esperance.

wider leaves than other specimens of the western morphotype. The overall pattern in leaf dimensions correlates significantly ( $p < 0.05$ ) with mean annual aridity index (AI; Table 2). The Cape Leeuwin plants, which do not conform to this trend, were collected from near-coastal sites and are likely to be short-leaved due to the influence of the coastal environment. *Calytrix* sp. Tutunup has leaves more similar to the eastern than the geographically closer western variant of *C. sp. Esperance* (Figure 2).

There is significant overlap in leaf dimensions between *C. sp. Eneabba* and *C. sp. Wheatbelt*, although the northernmost populations of *C. sp. Eneabba* have longer leaves than the rest (Figure 3). The Calingiri form of *C. sp. Wheatbelt* occurs at the boundary between the two putative taxa, and has much shorter leaves than either. Variations in leaf morphology were not significantly correlated with AI ( $p > 0.05$ ), with the exception of leaf width ( $p < 0.05$ ; Table 2). However, the correlation was non-significant ( $p > 0.05$ ) once a suspected outlier population (Collie; PERTH 02157195) was removed from the analysis. A separate analysis of *C. sp. Wheatbelt* alone showed significant correlation ( $p < 0.05$ ) of both leaf length and length:width ratio with AI (Table 2). However, these differences were non-significant ( $p > 0.05$ ) when the Calingiri form was excluded from the analysis.

**Table 2.** Pairwise t-test summary results: relationship between leaf morphology and associated aridity indices and geographic coordinates. Note: \*, \*\* and \*\*\* represent significance levels of  $p < 0.001$ , 0.01 and 0.05 respectively.

Taxon	Leaf characters	Aridity index	p-value	
			Longitude	Latitude
<b><i>C. sp. Esperance</i></b>	length (mm)	3.24e-05 ***	5.93e-05 ***	0.0421 *
	width (mm)	0.01094 *	0.00082 ***	0.14918
	length:width ratio	7.37e-05 ***	5.24e-05 ***	0.0276 *
<b><i>C. sp. Wheatbelt–sp. Eneabba</i></b>	length (mm)	0.99981	0.00120 **	0.00474 **
	width (mm)	0.018249 *	0.740013	0.000473 ***
	length:width ratio	0.4804	0.0117 *	1.77e-05 ***
<b><i>C. sp. Wheatbelt–sp. Eneabba (excluding Collie outlier)</i></b>	length (mm)	0.245968	0.000517 ***	0.037543 *
	width (mm)	0.64861	0.93311	0.00145 **
	length:width ratio	0.38859	0.00535 **	0.00015 ***
<b><i>C. sp. Wheatbelt</i></b>	length (mm)	0.0031 **	0.2751	0.635
	width (mm)	0.5233	0.1132	0.0299 *
	length:width ratio	0.0303 *	0.0436 *	0.1703
<b><i>C. sp. Wheatbelt (excluding Calingiri form)</i></b>	length (mm)	0.0746	0.2102	0.2292
	width (mm)	0.5709	0.1015	0.0365 *
	length:width ratio	0.524	0.586	0.226
<b><i>C. sp. Eneabba</i></b>	length (mm)	0.6957	1.23e-06 ***	0.0235 *
	width (mm)	0.9297	0.0312 *	0.8966
	length:width ratio	0.697	3.85e-07 ***	0.0114 *

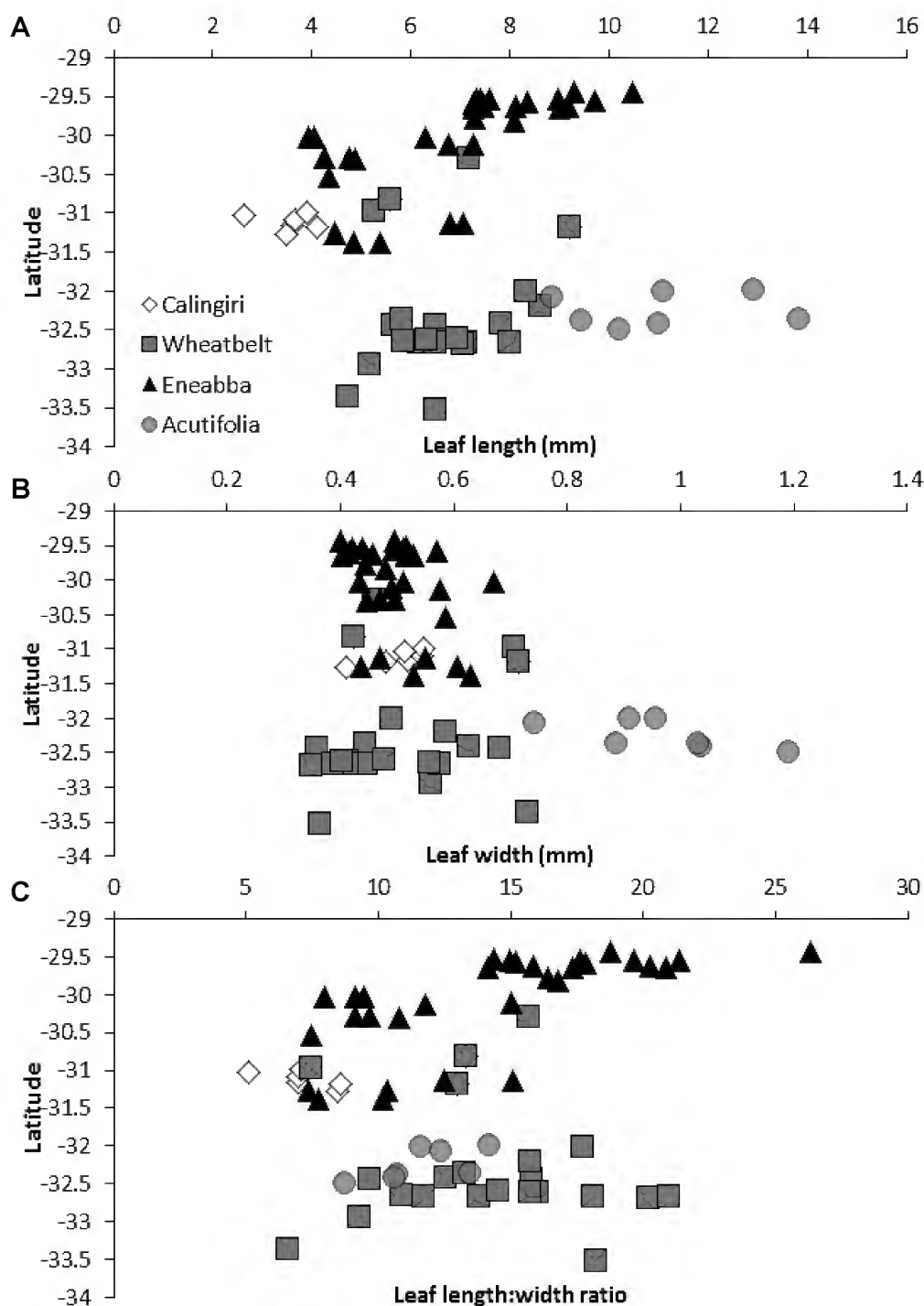


Figure 3. Variation in leaf morphology of *Calytrix acutifolia*, *C. sp.* Eneabba (B.J. Lepschi & T.R. Lally BJL3617) and *C. sp.* Wheatbelt (R. Davis 4544) against geographic locality (as latitude) of specimens examined in PERTH. A – leaf length (mm); B – leaf width (mm); C – leaf length:width ratio. Taxon name ‘Calingiri’ refers to the Calingiri form of *C. sp.* Wheatbelt.

In summary, of the seven currently recognised potential taxa in the *C. acutifolia* complex (including two variants of *C. sp. Esperance* and the Calingiri form of *C. sp. Wheatbelt*), four taxa are supported by this analysis based on clear and consistent morphological differences in indumentum, leaf, bracteole, hypanthium and floral characters. *Calytrix sp. Wheatbelt* and *C. sp. Eneabba* are not supported as distinct from each other, and are here combined into a single taxon; the Calingiri variant of this taxon is unusual in leaf dimensions but is otherwise typical. The eastern and western variants of *C. sp. Esperance* comprise two ends of a geographic cline, probably caused by increasing aridity towards the eastern end of the range of the taxon (with unusually short-leaved individuals from near Cape Leeuwin probably resulting from near-coastal environmental conditions).

Since the four recognised taxa show consistent and non-overlapping morphological differences, species rank is assigned to them here. All four taxa are allopatric.

### Key to species of the *Calytrix acutifolia* complex

1. Bracteoles with translucent wings that extend and overlap to the apex, covering  $> 3/4$  the length of the hypanthium; corolla 7.5–10 mm long; leaf blades 0.6–1.1 mm wide, with a distinct, protruding adaxial midrib, depressed-triangular in TS with a concave adaxial surface (Lesmurdie–Oakley)..... ***C. acutifolia***
- 1: Bracteoles with translucent wings reduced, the hypanthium clearly visible, or with translucent wings that extend and overlap for  $< 1/2$  the length of the hypanthium; corolla  $< 7$  mm long; leaf blades  $< 0.6$  mm wide, lacking a protruding adaxial midrib, depressed-triangular to obovate in TS..... **2**
2. Leaf blades obtriangular to depressed-obtriangular in TS, glabrous to prominently ciliate on margins, the hairs 0.05–0.2 mm long; stems with hairs 0.05–0.15(–0.2) mm long (Dongara–Narrogin)..... ***C. cravenii***
- 2: Leaf blades depressed-angular-obovate in TS, glabrous to sparsely ciliate on margins, the hairs to 0.05 mm long; stems with hairs 0.2–0.5 mm long ..... **3**
3. Hypanthium (2–)2.5–3.5 mm long, mostly 6–8-ribbed, smooth to somewhat rugose between the ribs; leaves patent at maturity (Yallingup–Esperance)..... ***C. hirta***
- 3: Hypanthium 1.5–2 mm long, 5-ribbed, markedly rugose between the ribs; leaves reflexed at maturity (Busselton–Tutunup)..... ***C. retrorsifolia***

### Taxonomy

***Calytrix acutifolia*** (Lindl.) Craven, *Brunonia* 10(1): 122–123 (1987). *Lhotskya acutifolia* Lindl., *Sketch Veg. Swan R.* 7 (1839). *Type*: [not cited] Swan River [Western Australia], 1839 [1835–1838], *J. Drummond s.n.* (*lecto*: CGE, designated by L.A. Craven, *Austral. Syst. Bot.* 10: 122 (1987); *isolecto*: G 00227522 image!, G 00227546 image!, K 000821951 image!).

*Calytrix sp.* Scarp (H. Bowler 270), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 14 December 2016].

Erect, open *shrubs* 0.6–2 m high. *Young stems* abundantly pilose with hairs 0.05–2 mm long, red-brown on new growth, with prominent leaf scars on older stems. *Leaves* alternate to partially subopposite; foliar colleters absent; petioles 1–1.2 mm long, yellow, glabrous; blades linear, 8.6–12.6 mm long, 0.6–1.1 mm wide, depressed-triangular in TS with a concave adaxial surface and distinct midrib protruding from the abaxial surface, glabrous; oil glands obscure to sometimes prominent; apex acute to acuminate. *Inflorescences* 20–130 mm long, 5–10 mm below shoot apex; peduncles 1–1.5 mm long,

glabrous to ciliate, slightly extended between bracteoles at apex; bracteoles green to light brown, glabrous, 4–5 mm long, free or slightly connate at base, with entire margins and long-acuminate apex, prominently translucent-winged with the wings overlapping and as long as the hypanthium. *Flowers* 5-merous, 15.5–16.7 mm diam.; hypanthium 5–7-ribbed, subcylindrical, 3.5–4.5 mm long, glabrous, smooth between the ribs; sepals 1–2.3 mm long, 1–1.5 mm wide, glabrous, the margin entire to slightly erose, the apex emarginate to obtuse-truncate, lacking awns; petals 7.5–10 mm long, 2–2.5 mm wide, white (pale yellow in bud), glabrous; staminodes absent; stamens 40–85, white, 2–4-seriate, the longest filaments 5–7 mm long, the anthers *c.* 0.3 mm long, cream to light yellow; style 6.5–7.5 mm long, white. *Seed* not seen. (Figure 4A)

*Selected specimens examined.* WESTERNAUSTRALIA: Serpentine, between Perth and Pinjarra, Nov. 1899, *C. Andrews s.n.* (PERTH); Mills Rd, 0.5 km E of Metro Water Supply access road, Gosnells, 2 Nov. 1979, *R.J. Cranfield* 984/79 (PERTH); Gooseberry Hill, Darling Range, 21 Oct. 1897, *R. Helms s.n.* (PERTH); Serpentine National Park, *c.* 750 m ESE of Chatfield Rd on upper slope below granite, 31 Oct. 1996, *A. Markey* 495 (PERTH); Lesmurdie National Park, Falls Rd, Lesmurdie, NW of carpark 30 m, N of walking track, 9 Dec. 1996, *A. Markey* 923 (PERTH); Bodhinyana Monastery, 216 Kingsbury Drive, Serpentine, 12 Oct. 2002, *B. Nyanatusita* 262 (PERTH); Oakley Dam, *c.* 300 m W of dam wall, 17 Nov. 1992, *S. Patrick* 1401 (PERTH); 45 miles out Brookton Hwy, 27 Sep. 1959, *L. Steenbohm s.n.* (PERTH).

*Phenology.* Flowers from September to November, with a peak from mid-October to early November.

*Distribution and habitat.* Confined to the escarpment of the Darling Range and adjacent foothills of the Pinjarra Plain, from Helena Valley to Oakley Dam (Figure 5). Populations are restricted to two main centers along the escarpment, one east of Perth and the other in Oakley. A disjunct collection (*L. Steenbohm s.n.*) is from *c.* 50 km east of the main distribution, along the Brookton Highway; it is morphologically typical. Grows on hill slopes and gullies over granite, in lateritic gravel, clay, and/or gritty loam, in wandoo and marri woodlands, with understorey species including *Grevillea endlicheriana*, *Hakea undulata*, *Trymalium ledifolium*, *Darwinia citriodora* and *Acacia pulchella*.

*Conservation status.* *Calytrix acutifolia* is restricted in range but is not considered to be at risk. Over half of the populations are found in national parks and nature reserves.

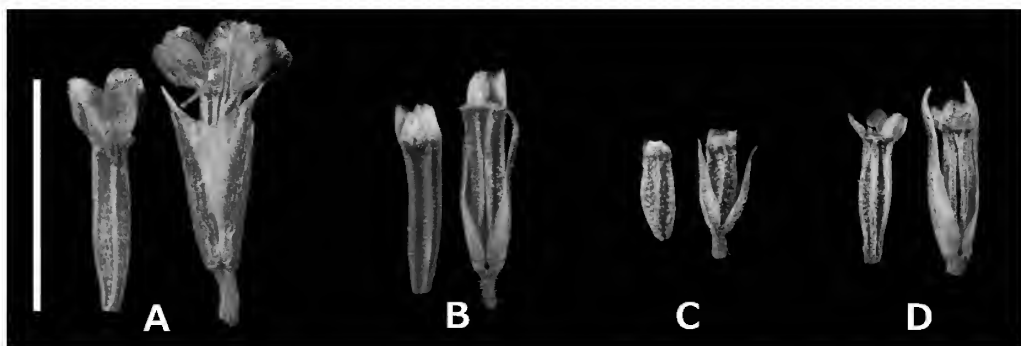


Figure 4. Hypanthium and bracteole structure of the four study species. A – *Calytrix acutifolia* (PERTH 06739822); B – *C. cravenii* (PERTH 07213751); C – *C. retrorsifolia* (PERTH 06062059); D – *C. hirta* (PERTH 01955117). Scale bar = 4 mm.

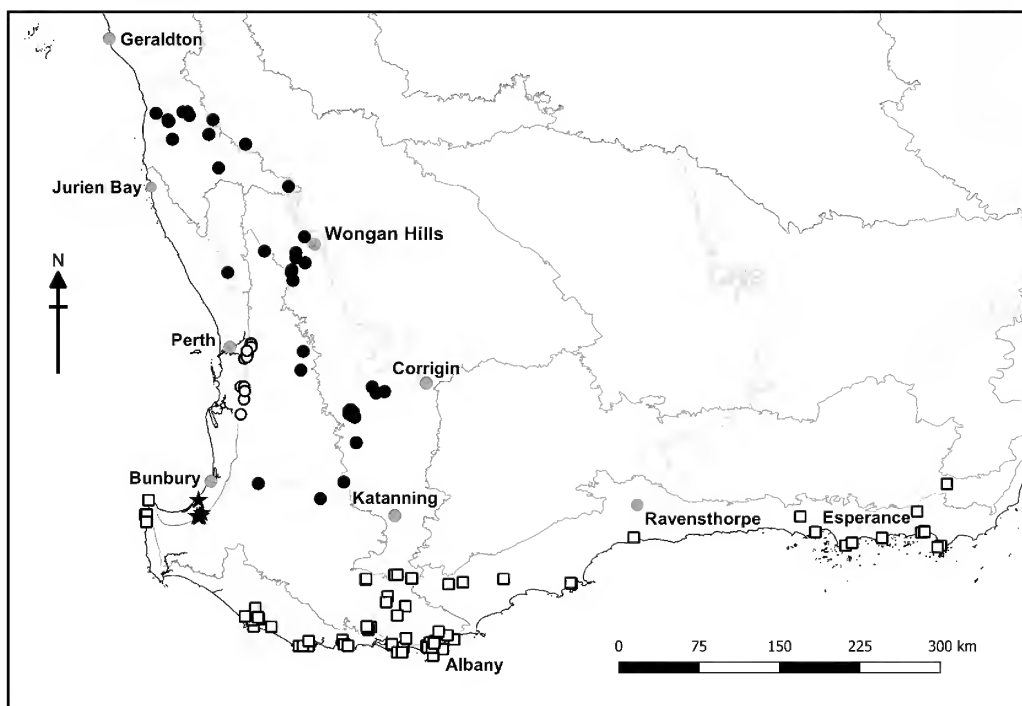


Figure 5. Distribution of *Calytrix acutifolia* (○), *C. hirta* (□), *C. retrorsifolia* (★), and *C. cravenii* (●) in south-west Western Australia.

*Notes.* *Calytrix acutifolia* is the most distinctive member of the complex, differing from all others by its larger leaves (0.6–1.1 mm wide and to 12.6 mm long) and flowers (7.5–10 mm long). Its leaves, hypanthium, and bracteoles are always glabrous, while all other members of the complex have an indumentum on some or all of these parts. In addition, its bracteoles have prominent translucent wings that extend and overlap to the bracteole apex (and hence cover most of the hypanthium), while other species have narrower wings that overlap to a lesser extent, with the upper half or more of the hypanthium exposed. It is the only species in the complex that occurs on the escarpment of the Darling Range.

***Calytrix cravenii* Nge & Thiele, *nom. nov.***

*Lhotskyia scabra* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* II. 324 (1862). *Type*: ‘Nova Hollandia. Gilbert n. 186.’ (*lecto*: KW 1001262 image!, inadvertently designated by L. Craven, *Austral. Syst. Bot.* 10: 122 (1987); *isolecto*: K 821950 image!).

*Calytrix* sp. Eneabba (B.J. Lepschi & T.R. Lally BJL3617), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 14 December 2016].

*Calytrix* sp. Wheatbelt (R. Davis 4544), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 14 December 2016].

Erect, open *shrubs* 0.5–2 m high. *Young stems* abundantly pilose with hairs 0.05–0.15(–0.2) mm long, mottled cream and pale brown or red-brown on new growth, with prominent leaf scars on older stems. *Leaves* alternate to partially subopposite; foliar colleters absent; petioles 0.5–1 mm long,

yellow, glabrous to ciliate; blades linear to linear-oblongate, 3–11 mm long, 0.3–0.9 mm wide, depressed-triangular in TS, glabrous to prominently ciliate with hairs 0.05–0.2 mm long; oil glands usually absent, sometimes noticeable; apex acute to obtuse. *Inflorescences* 20–100 mm long, 2–10 mm below shoot apex; peduncles 0.5–0.8 mm long; bracteoles green to light brown, ciliate along midrib, 2–3.5 mm long, free and sparingly connate at base, with entire margins and long-acuminate apex, translucent wings reduced and scarcely overlapping. *Flowers* 5-merous, c. 10–15 mm diam.; hypanthium 5-ribbed, subcylindrical, (1.7–)2.5–4 mm long, smooth or rugose-pitted between the ribs, glabrous to finely ciliate, with two rows of hairs present along each rib; sepals 0.6–1.1 mm long, 0.2–0.8 mm wide, glabrous, the margin erose, the apex obtuse-truncate, lacking awns; petals (4–)6(–7) mm long, 1.5–1.7 mm wide, white (pale yellow in bud), glabrous; staminodes absent; stamens 18–29, white, 2-seriate, the longest filaments 4–5 mm long, the anthers 0.2–0.3 mm long; style (4–)5–6 mm long, white. *Seed* not seen. (Figure 4B, 6A)

*Diagnostic features.* The following combination of characters can be used to differentiate *C. cravenii* from other species within the complex: leaf in transverse section depressed-triangular; leaf blades usually ciliate with prominent indumentum to 0.2 mm long (rarely glabrous); hairs along pilose stems 0.05–0.15 long; petals usually c. 6 mm long (Calingiri form c. 4 mm long); leaf blades linear to linear-oblongate.

*Other specimens examined.* WESTERN AUSTRALIA: 6.7 miles E of Carani, 30 Aug. 1971, T.E.H. Aplin 4881 (PERTH); 22.4 miles from Coorow on Green Head road, 7 Nov. 1978, C. Chapman (30)78 (PERTH); 3 km along Morawa water supply road from the Arrino West Rd, 2 Oct. 1981, L.A. Craven & C. Chapman 6843 (CANB); Duranillin–Bowelling Rd, 1 km W of Duranillin, 18 Nov. 1997, R. Davis 4544 (PERTH); road verge Prices Rd, NW of Moora, 1 Oct. 1988, E.A. Griffin 5402 (PERTH); quadrat POPO13 Landsell remnant bushland Popanyinning, 13 Nov. 1996, A.G. Gunness *et al.* POPO 13/45 (PERTH); Calingiri Water Reserve 17655/29461, Fordham Rd, Calingiri, Shire of Victoria Plains, c. 100 m S of the railway crossing on Fordham Rd, between road and railway line, 6 Aug. 2005, F. Hort & J. Hort FH 2568 (PERTH); Lot 4, E of Moore River National Park, 9 Oct. 2002, G.J. Keighery & N. Gibson *s.n.* (PERTH); W side of the Wongan Hills, c. 200 km NE of Perth, 29 Oct. 1980, K.F. Kenneally 7511 (PERTH); spring-fed creek 30 km NE of Eneabba on edge of unnamed NR A12705, E side of Skipper Rd 4 km NNE of intersection of Bunney Rd and Skipper Rd. SAP wetlands site SPS180B, 23 Sep. 1999, M.N. Lyons & S.D. Lyons 3534 (PERTH); wetland within Martinjinni NR C2736, 20 km WSW of Dalwallinu, 1.0 km NNE of SW corner of reserve on E side of road, NE side of wetland, SAP wetlands site SPS155B, 5 Oct. 1999, M.N. Lyons & S.D. Lyons 3528 (PERTH); Jingaring Nature Reserve, Jingaring road, c. 30 km ENE of Pingelly, 7 Nov. 1999, L.W. Sage, R. Davis & F. Obbens LWS 1328 (PERTH); Reserve 424, off West Talbot Rd, York, 16 Nov. 2001, H. Seeds 176 (PERTH).

*Phenology.* Flowers from spring to early summer (early September to early December), with a peak in October–November.

*Distribution and habitat.* Wide-ranging, found in a range of habitats in the Geraldton Sandplains and Avon Wheatbelt bioregions, from Dongara to Wongan Hills, south to Narrogin (Figure 5), commonly on sandplains (white, grey, or yellow sandy soils) with associated kwongan heath or low woodland vegetation communities. A few populations are found near riverbanks and valleys, on dry white sand or damp sandy clay along drainage lines. An outlying specimen from the Collie area (PERTH 02157195) may have been introduced with road materials, as it is well to the west of the main distribution and is the only collection known to occur in the Jarrah Forest bioregion.

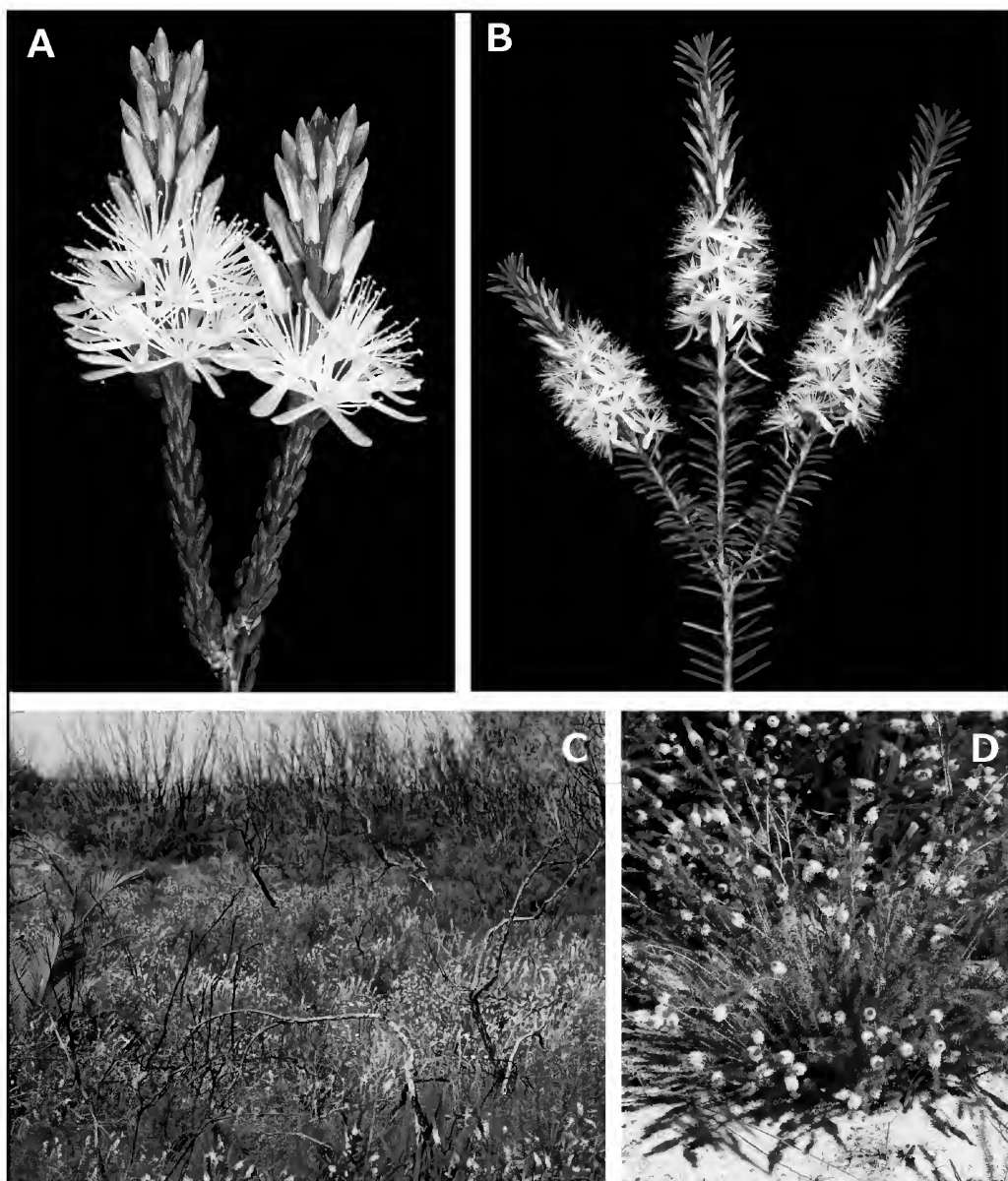


Figure 6. Morphology and habitat of study species. A – *Calytrix cravenii* Calingiri form (K.R. Thiele 4006), B – *C. hirta* (K.R. Thiele 5408), C – habitat of *C. hirta*, D – resprouting shrub of *C. hirta* (K.R. Thiele 5408). Photographs by K. Thiele (A, B) and F. Nge (C, D).

**Conservation status.** Not considered to be at risk; widespread throughout its range although many populations are found on road verges where little native vegetation remains.

**Typification.** Craven's (1987) type citation for *Lhotskya scabra* ('KW, holo.; K, W, iso.') comprises an inadvertent lectotypification of KW 1001262 under Art. 9.9 of the *International Code of Nomenclature for algae, fungi, and plants* (McNeill *et al.* 2012). The epithet *scabra* is pre-occupied in *Calytrix* by *C. scabra* DC.

**Etymology.** This species is named in honour of Dr Lyndley (Lyn) Alan Craven (1945–2014), a prominent figure in the Australasian plant systematic community who made substantial contributions to the field including a revision of the genus *Calytrix*.

**Affinities and notes.** *Calytrix cravenii* has the greatest variation in leaf and floral characters of all the members within the complex. Ciliate leaf margins are more prominent on *C. cravenii* than any other member in the complex. Most specimens in addition have leaf blades that are extensively covered in hairs. A few specimens (PERTH 04741854, PERTH 02157187, PERTH 04474058) have glabrous leaves. Whether these are only limited to the specimens collected or are consistent within their population requires further investigation. Northern populations of *C. cravenii* have more sparsely spaced cilia on their leaf blade margins, often increasing proximally to more strongly ciliate petioles. The hypanthium of *C. cravenii* is longer than most other members within the complex (with the exception of *C. acutifolia*), a feature that is often noticeable in the field.

Some collections from the Calingiri area have shorter leaves, petals and hypanthia than the typical form; however, typical specimens of *C. cravenii* have also been collected from near Calingiri (e.g. PERTH 01232649), close to populations of the Calingiri form. Further field observations (and perhaps molecular studies) are needed to establish whether these are phenotypic variants of a single variable taxon, or represent a distinct species; the Calingiri plants are here provisionally included in *C. cravenii* pending such studies.

***Calytrix hirta* (Regel) Nge & K.R.Thiele, *comb. nov.***

*Lhotskya hirta* Regel, *Gartenflora* 12: 337, t. 415, Figures 1–4 (1863). *Type citation*: ‘Entwickelt im Mai seine weissen Blumen und gedeiht bei gleicher Clatur, ve die Leptospermum-Arten und andere weniger zarte Neuhollander.’ *Type specimens*: Ex horto bot. Petropolitano [from a plant cultivated in a botanic garden at St Petersburg (Leningrad)], *leg. ign.* 66.4 (*lecto*: LE 00015414 image!, inadvertently designated by L. Craven, *Austral. Syst. Bot.* 10: 122 (1987); *syn*: Ex horto bot. Petropolitano, *leg. ign.* 63.5 (LE 00015416 image!)).

*Lhotskya ericoides* Schauer in J. Lindley, *Nat. Syst. Bot.* Edn. 2: 439 (1836). *Type citation*: ‘Hab. frequens in collibus circa sinum Regis Georgii III. in Novae Hollandiae ora australi-occidentali, ubi florentem legit Decembri M, 1821. All. Cunningham, qui sicca specimina benigne mecum communicavit.’ *Type specimen*: on the hills around King George Sound, Western Australia, Dec. 1821, *A. Cunningham* 232 (*syn*: MEL 545054 image!)

*Calytrix* sp. Esperance (M.A. Burgman 4268A), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 14 December 2016].

Multi-stemmed, spreading *shrubs* 0.5–2.5 m high. *Young stems* abundantly pilose with hairs 0.1–0.5 mm long, mottled cream and pale brown or smooth red-brown on new growth, with prominent leaf scars on older stems. *Leaves* alternate to partially subopposite; foliar colleters absent; petioles 0.5–0.7 mm long, yellow, glabrous; blades linear to slightly falcate, 3–11 mm long, 0.28–0.82 mm wide, depressed-angular-obovate in TS, glabrous to sparsely ciliate, with white-transparent hairs along the margins to 0.05 mm long; oil glands usually absent, sometimes noticeable; apex acute to obtuse. *Inflorescences* 20–80 mm long, 5–10 mm below shoot apex; peduncles *c.* 0.5 mm long; bracteoles green to light brown, glabrous to ciliate along midrib, 3–4 mm long, only connate at base, with entire margins and long-acuminate apex, translucent wings reduced and scarcely overlapping. *Flowers* 5-merous,

8–10(–13) mm diam.; hypanthium usually 6–8-ribbed, subcylindrical, (2–)2.5–3.5 mm long, smooth or rarely rugose between the ribs, sometimes slightly spotted, glabrous to finely ciliate, with hairs to 0.05 mm long; sepals 0.5–1.0 mm long, 0.2–0.8 mm wide, glabrous, the margin entire to slightly erose, the apex emarginate to obtuse-truncate, lacking awns; petals 4–5.5(–7) mm long, 0.8–1.5 mm wide, white (pale yellow in bud), glabrous; staminodes absent; stamens 32–46, white, 2-seriate, the longest filaments (3.5–)4–5 mm long, the anthers *c.* 0.3 mm long, cream to light yellow; style 4.5–5.5 mm long, white. *Seed* smooth, light cream-brown, narrowly obovoid, 1.5–2 mm long. (Figures 4D, 6B–D)

*Diagnostic features.* The following combination of characters can be used to differentiate *C. hirta* from other species within the complex: bracteoles with translucent wings reduced with hypanthium clearly visible; hypanthium > 2 mm (2.5–3.5 mm) long; longest pilose hairs along stems > 0.2 mm (usually to 0.5 mm long); leaf transverse section angular-obovate; leaf blades generally glabrous, few sparsely ciliate with indumentum < 0.05 mm long. The leaves of *C. hirta* are also perpendicular (patent) to the stem.

*Other specimens examined.* WESTERNAUSTRALIA: Denmark Block JQ136, 18 on Denmark River, 7 Dec. 1983, *A.R. Annels* 1760 (PERTH); East Mt Barren, 28 Oct. 1963, *T.E.H. Aplin* 2709 (PERTH); site 8C, Bibbulmun Track, Irwin Inlet - Boat Harbour Campsite, 29 Oct. 2001, *T. Evans* 783 (PERTH); Bremer Bay, 12 Oct. 1942, *C.A. Gardner* 6557 (PERTH); 1.5 m along track to Bluff Knoll from Chester Pass Rd, 15 Nov. 1959, *A.S. George* 434 (PERTH); near Boggy Lake, 6 miles SW of Walpole, 2 Dec. 1956, *J.W. Green* 1022 (PERTH); 9.6 km SE of Northcliffe–Windy Harbour Rd on Chesapeake Rd, 24 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* BJL 3653 (PERTH); *c.* 14.5 km SSE of Northcliffe, Mt Chudalup, 26 Nov. 1974, *B. Muir s.n.* (PERTH); Cape Naturaliste, 19 Sep. 1973, *E. Charles Nelson* ANU 17241 (CANB, PERTH); Wireless Hill, Esperance, 9 Oct. 1974, *B.L. Powell* 74117 (PERTH); Cape Arid National Park, E of Esperance, 1 Dec. 1971, *R. D. Royce* 9950 (PERTH); Two Peoples Bay Reserve, near Albany, Apr. 1975, *R.E.S. Sokolowski* 15/75 (PERTH); Cape Le Grand National Park, by Thistle Cove, 7 Nov. 1982, *A. Strid* 21220 (PERTH).

*Phenology.* Flowers from late September to late December, with a peak in late spring to early summer.

*Distribution and habitat.* Occurs in the Cape Naturaliste area, along the south coast from Walpole to Esperance, and inland to the Stirling Range (Figure 5). There are two main centres of distribution, from Walpole to Bremer Bay and from the Esperance area to Cape Arid National Park. Far-western populations growing on coastal dunes around Cape Naturaliste are disjunct from the main distribution. *Calytrix hirta* is commonly found on coastal to near-coastal dunes and on alluvial soils around granite outcrops. Four collections from the western end of the range are from river embankments or swamps, often next to granite. Associated vegetation includes low coastal heath, *Acacia* thickets, karri forest, *Eucalyptus* and *Agonis* open woodlands, and *Melaleuca* thickets.

*Conservation status.* Not considered to be at risk, widespread throughout the south coast with many populations currently protected under nature reserves.

*Typification.* Craven's (1987) type citation for *Lhotskya hirta* ('LE, holo.') comprises an inadvertent lectotypification under Art. 9.9 of the *International Code of Nomenclature for algae, fungi, and plants* (McNeill *et al.* 2012). The epithet of the first available name for this species (*L. ericoides* Schauer, 1836) is preoccupied in *Calytrix* by *C. ericoides* A.Cunn.

**Affinities and notes.** *Calytrix hirta* shares many characters with *C. retrorsifolia* Nge & Keighery, suggesting that they may be closely related. The longer and more prominent hairs (0.1–0.5 mm long) along their pilose stems in addition to shorter cilia (< 0.05 mm long) on their leaf margins distinguish them from other members of the complex. However, *C. hirta* has a longer hypanthium (2.5–3.5 mm *cf.* 1.5–2 mm in *C. retrorsifolia*), and leaves that are perpendicular to the stem as opposed to reflexed at maturity. The hypanthium of *C. retrorsifolia* is always shorter than the subtending bracteoles (cheridium), while in *C. hirta* it is subequal or longer. *Calytrix retrorsifolia* on average has shorter leaves (3.7–7.3 mm; mean = 4.5 mm) than *C. hirta* (3–11 mm; mean = 7.29 mm), although the range in leaf length overlaps. In addition, *C. hirta* is found in a wide range of habitats in contrast to the restricted range and habitat of *C. retrorsifolia* (confined to ironstones near Busselton).

Two leaf variants of *C. hirta* correspond with its two main areas of distribution. However, an interrupted cline is evident across the geographic disjunction between the two, with four geographically intermediate populations (three around Bremer Bay and one at East Mt Barren) having leaves that are intermediate between the two variants. Apart from these differences in leaf length and width, other characters examined are consistent throughout their range. Within the *C. acutifolia* species complex, *C. hirta* exhibits the greatest variation in the texture of its hypanthium. Hypanthia in most populations are smooth and strongly ribbed (similar to other members within the complex), with some populations (e.g. East Mt Barren, PERTH 02157098; Bremer Bay, PERTH 01953117, PERTH 06268579) having a spotted pattern. A few populations have smooth to slightly rugose hypanthia (e.g. D’Entrecasteaux National Park, PERTH 07887809; Yallingup, PERTH 07010753).

Four specimens collected from coastal dunes near Cape Naturaliste are disjunct by *c.* 100 km from the main area of distribution. They are more stunted in growth, and have shorter and thicker leaves than the typical western variant (Figure 2) and hypanthia that are shorter than the subtending bracteoles. In contrast to the green to brown hypanthia of other populations of *C. hirta*, these coastal populations have hypanthia that are light cream to pale brown (with the exception of one specimen, PERTH 02157373). The translucent wings of the bracteoles are more pronounced, covering up to half the hypanthium, and have strongly erose margins. We assume here that these differences are caused by their near-coastal habitat, but these populations are worthy of further study.

Potential pollinators of *C. hirta* were noted during field collection and observations taken during the course of this study. Flowering plants observed in November were often covered with beetles, primarily *Stenodorus suturalis* (Cerambycidae: Coleoptera) but also species from Mordellidae. *Stenodorus* were seen walking over fresh inflorescences and feeding on pollen. Unlike many other species of *Calytrix*, field observations indicate that *C. hirta* does not change its floral colour following successful pollination or after senescence (Lamont 1985).

***Calytrix retrorsifolia* Nge & Keighery, *sp. nov.***

**Type:** Tutunup, Western Australia [precise locality withheld for conservation reasons], 16 October 2001, G.J. Keighery & N. Gibson 2953 (*holo:* PERTH 06062075; *iso:* AD, CANB, K, MEL, NY).

*Calytrix* sp. Tutunup (G.J. Keighery & N. Gibson 2953), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 14 December 2016].

Slender, spreading, open *shrubs* 0.3–2 m high. *Young stems* abundantly pilose with hairs 0.1–0.5 mm long, mottled cream and pale brown or red-brown on new growth, with prominent leaf scars on older

stems. *Leaves* alternate to partially subopposite, reflexed at maturity on main stems below inflorescences; foliar colleter absent; petioles 0.5–1 mm long, yellow, glabrous to slightly pubescent; blades linear to slightly falcate, 3.7–7.3 mm long, 0.3–0.45 mm wide, depressed-angular-obovate in TS, glabrous to sparsely ciliate with white-transparent hairs along the margins to 0.05 mm long; oil glands usually absent, sometimes noticeable; apex acute. *Inflorescences* 20–100 mm long, 5–10 mm below shoot apex; peduncles c. 0.5 mm long; bracteoles green to light brown, glabrous to ciliate along midrib, 1.5–3 mm long, only connate at base, with entire margins and long-acuminate apex, translucent wings reduced and scarcely overlapping. *Flowers* 5-merous, 8–9.5 mm diam.; hypanthium 5-ribbed, subcylindrical, 1.5–2 mm long, markedly rugose between the ribs, glabrous; sepals 0.3–0.6 mm long, 0.4–0.5 mm wide, glabrous, the margin entire, the apex rounded to obtuse-truncate, lacking awns; petals 4–5 mm long, 0.5–1.3 mm wide, white (pale yellow in bud), glabrous; staminodes absent; stamens 23–40, white, 2-seriate, the longest filaments 3–4 mm long, the anthers 0.2–0.3 mm long, light yellow; style 3.5–5 mm long, white. *Seed* not seen. (Figure 4C)

*Diagnostic features.* The following combination of characters can be used to differentiate *C. retrorsifolia* from other species within the complex: hypanthium distinctly rugose, with a reticulate-pitted texture; leaves reflexed at maturity; bracteoles always longer than the hypanthium; hypanthium 1.5–2 mm long; bracteoles with translucent wings reduced with hypanthium clearly visible; longest hairs along pilose stems > 0.2 mm (usually to 0.5 mm) long; leaf blade in transverse section angular-obovate; leaves generally glabrous, rarely sparsely ciliate with hairs < 0.05 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 Oct. 2008, *E. Bennett* 8/6 (PERTH); 3 Oct. 2001, *B. Jennings s.n.* (PERTH); 5 Oct. 2001, *B. Jennings per M. Soutar s.n.* (PERTH); 16 Oct. 2001, *G.J. Keighery & N. Gibson* 2953 (PERTH); 16 Oct. 2001, *G.J. Keighery & N. Gibson* 2956 (PERTH); 30 Oct. 1974, *G.S. McCutcheon* GSM 525 (PERTH); 25 Jan. 2001, *G.S. McCutcheon* 3018 (PERTH); 25 Jan. 2001, *G.S. McCutcheon* 3019 (PERTH).

*Phenology.* Flowers mostly in October.

*Distribution and habitat.* Restricted to shallow red clays and/or yellow sands over massive ironstones at the base of the Whicher Range south-east of Busselton (Figure 5). Plants are killed by fire and germinate prolifically the following winter forming dense stands of increasingly tall shrubs. Found in shrublands and *Eucalyptus* and *Banksia* woodlands. Associated species include *Grevillea elongata*, *G. manglesioides*, *Eucalyptus rudis*, *Banksia attenuata*, and *Jacksonia horrida*.

*Conservation status.* Listed by Smith (2017) as Priority Two under Conservation Codes for Western Australian Flora, as *C. sp.* Tutunup (*G.J. Keighery & N. Gibson* 2953). Highly restricted in range but locally abundant where it occurs. Currently known from two proposed nature reserves and a ‘flora road’ verge.

*Etymology.* The epithet is from the Latin *retrorsus* (turned or bent backwards) and *-folius* (-leaved), referring to the mature leaves that are closely retrorse on the stems.

*Affinities.* See under *C. hirta* for affinities and notes.

### Acknowledgements

We thank Mike Hislop for providing us with his perspective on the taxonomic status of some of the members within the *Calytrix acutifolia* species complex. We would like to thank Andras Szito for his

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## A taxonomic revision of the basin-like rosetted triggerplants of the *Stylidium piliferum* complex (Stylidiaceae) from south-western Australia

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### Abstract

Lowrie, A. & Kenneally, K.F. A taxonomic revision of the basin-like rosetted triggerplants of the *Stylidium piliferum* complex (Stylidiaceae) from south-western Australia. *Nuytsia* 28: 339–382 (2017). A taxonomic revision of the basin-like rosetted triggerplants of the *Stylidium piliferum* R.Br. complex (Stylidiaceae) from the south-west of Western Australia is presented. Fifteen species are recognised including the new species *S. amphora* Lowrie & Kenneally, *S. bindoon* Lowrie & Kenneally, *S. monticola* Lowrie & Kenneally, *S. nitidum* Lowrie & Kenneally, *S. ponticulus* Lowrie & Kenneally, *S. salmoneum* Lowrie & Kenneally, *S. strigosum* Lowrie & Kenneally and *S. vinosum* Lowrie & Kenneally. Revised descriptions are provided for seven named species: *S. bicolor* Lindl., *S. ciliatum* Lindl., *S. ferricola* Wege & Keighery, *S. hispidum* Lindl., *S. miniatum* Mildbr., *S. piliferum* and *S. pubigerum* Sond. All species are illustrated and a key is also provided.

### Introduction

This paper presents a taxonomic revision of those species of *Stylidium* Sw. (Stylidiaceae) that share a similar life form to that found in the first-named species in this complex, *S. piliferum* R.Br. (subg. *Tolypangium* (Endl.) Mildbr. sect. *Lineares* (Benth.) Mildbr.). Species in this complex are endemic to Western Australia and form a natural group characterised by crowded, more-or-less incurved leaves that are arranged to form a ‘basin-like’ rosette, a term created by Erickson (1958).

The *S. piliferum* complex is further characterised by: partly connate calyx lobes (with two lobes connate for most of their length and three free to their base or more rarely connate); vertically-paired corolla lobes, with the anterior pair larger than the posterior pair; the absence of throat appendages, and presence of coloured throat markings that serve as insect guides.

### Methods

This study is based on extensive field collecting, and studies in herbaria in Australia, the United Kingdom, Europe and the United States of America. We observed, photographed and collected most taxa during field studies conducted over many flowering seasons. One of us (AL) also collected fresh material, which was used either for preparation of voucher specimens (including spirit materials) or

to establish cultivated collections for further study. Morphological descriptions and illustrations were drawn up using dried, spirit, fresh and cultivated material.

*Stylidium* collections at the Western Australian Herbarium (PERTH) have been examined to determine their species status. Specimens in other herbaria were examined and photographed wherever it was possible to locate such material. In particular, one of us (KFK) examined Australian collections to identify type material in MEL and NSW as well as the following overseas herbaria: ABD, B, BM, C, E, G, GOET, HAL, HBG, K, L, LD, M, NY, P, S and UPS.

### Key to the basin-like rosetted triggerplants

1. Leaf margins ciliate or hispid
  2. Entire scape and inflorescence glandular; leaf margins ciliate ..... **S. ciliatum**
  - 2: Lower scape glabrous, upper scape and inflorescence glandular; leaf margins hispid..... **S. hispidum**
- 1: Leaf margins entire or serrulate
  3. Calyx with 2 connate and 3 connate lobes..... **S. pubigerum**
  - 3: Calyx with 2 connate and 3 free lobes
    4. Calyx lobes glabrous
      5. Hypanthium with glandular or non-glandular trichomes
        6. Hypanthium moderately to sparingly glandular; scapes ascending ..... **S. ferricola**
        - 6: Hypanthium densely covered with glandular or non-glandular trichomes; scapes erect
          7. Hypanthium indumentum of yellowish non-glandular trichomes; main body of calyx lobes glabrous with marginal hyaline a little irregular and minutely ciliate ..... **S. bindoon**
          - 7: Hypanthium indumentum of glandular trichomes arising from the apex of distinctive conical mounds; main body of calyx lobes glabrous, marginal hyaline serrulate, serrations irregularly very shortly ciliate, some cilia bearing glandular tips (scattered glands sometimes present on the calyx bases) ..... **S. miniatum**
      - 5: Hypanthium glabrous
        8. Pedicels glabrous..... **S. nitidum**
        - 8: Pedicels glandular ..... **S. monticola**
    - 4: Calyx lobes glandular
      9. Hypanthium narrowly oblong
        10. Hypanthium with glandular and non-glandular strigose trichomes ..... **S. strigosum**
        - 10: Hypanthium with glandular and non-glandular upright trichomes ..... **S. vinosum**
      - 9: Hypanthium ellipsoidal or obovoid
        11. Hypanthium broadly obovoid (ratio 6:4) ..... **S. amphora**
        - 11: Hypanthium ellipsoidal to narrowly obovoid (ratio 3:1)
          12. Leaves linear ..... **S. bicolor**
          - 12: Leaves oblanceolate

13. Corolla lobes with a distinctive bridge between the anterior and posterior pair; leaves silvery grey-green and shiny ..... **S. ponticulus**
- 13: Corolla lobes without a distinctive bridge between the anterior and posterior pair; leaves green and not shiny
14. Corolla lobes salmon-pink, with a reddish mark near the base of each posterior lobe; leaves 1.4–2 cm long, 1.5–2 mm at widest point ..... **S. salmoneum**
- 14: Corolla lobes white or pink, with yellow marks near the base of each posterior and anterior lobe; leaves 2–2.5 cm long, 1.5–1.6 mm at widest point ..... **S. piliferum**

### Taxonomy

**Stylidium amphora** Lowrie & Kenneally, *sp. nov.*

*Type:* Karomin Rocks, Nungarin, Western Australia, 12 October 1991, *A. Lowrie* 399 (*holo:* PERTH 08702470; *iso:* MEL).

*Stylidium* sp. Narembeen (W.E. Blackall *s.n.* /09/1929), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*; 20–28 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 3 tightly clustered rosettes arising from the apices of below-ground stems, with the bases adpressed to the soil surface, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, glabrous, oblanceolate, incurved, transversely narrowly semi-lenticulate in T.S., 3–4 cm long, 0.8–1 mm wide near the base, gradually dilating to 2–4 mm wide near the apex, *c.* 0.3 mm thick, margin translucent-white, hyaline,  $\pm$  entire or a little irregularly serrate, apical mucro translucent-white, stiff, 1–1.2 mm long. *Scape* green, glabrous; bracts absent. *Inflorescence* usually racemose, sometimes pedunculate in groups of 2 or 3 flowers, peduncles and pedicels 7–12 mm long, inflorescence densely covered throughout with short glandular trichomes 0.2–0.3 mm long; floral bracts green, glabrous, ovate, 2.5–3 mm long, 1–1.2 mm wide, margin hyaline,  $\pm$  entire, apical mucro translucent-white, stiff, 0.7–0.8 mm long; bracteoles similar to but much smaller than the floral bracts. *Hypanthium* green, broadly obovoid at anthesis, 5–5.5 mm long, 2–2.5 mm wide, densely covered with short glandular trichomes 0.2–0.3 mm long. *Calyx* with 2 lobes fused together for half their length, 1.8–2 mm long, 3 lobes free to their base, 2.5–2.7 mm long, margins entire, not hyaline, outer surface of the calyx sparsely covered with short glandular trichomes similar to those on the hypanthium. *Corolla* mostly always yellow but occasionally white or cream, abaxial surface yellow, glandular; lobes vertically-paired; anterior lobes 7–7.5 mm long, 2.5–3 mm wide, with red, triangular marks near the base, apical margins bearing glands; posterior lobes 6–6.5 mm long, 1.8–2.3 mm wide, with  $\pm$  crescent-shaped, reddish marks near the base. *Labellum* boss green,  $\pm$  narrowly obovate, *c.* 0.1 mm long, *c.* 0.8 mm wide, smooth; lateral appendages green, subulate, *c.* 0.7 mm long, *c.* 0.3 wide at the base; margins papillose, forming minute red beard *c.* 0.2 mm wide, with a few glands sometimes present. *Throat* yellow, appendages absent. *Gynostemium* *c.* 20 mm long, reddish, torus yellow; anthers reddish maroon, positioned *c.* 45° to the gynostemium, *c.* 3 mm long, *c.* 1.5 mm wide, margins with translucent-white, moniliform hairs *c.* 1.5 mm long; pollen pale yellow; stigma 1, gibbose, *c.* 1.5 mm long, *c.* 0.5 mm wide when mature. *Capsule* broadly obovoid, *c.* 7 mm long, *c.* 4.5 wide near its apex, *c.* 1 mm wide at the base. *Seeds* not seen. (Figure 1)

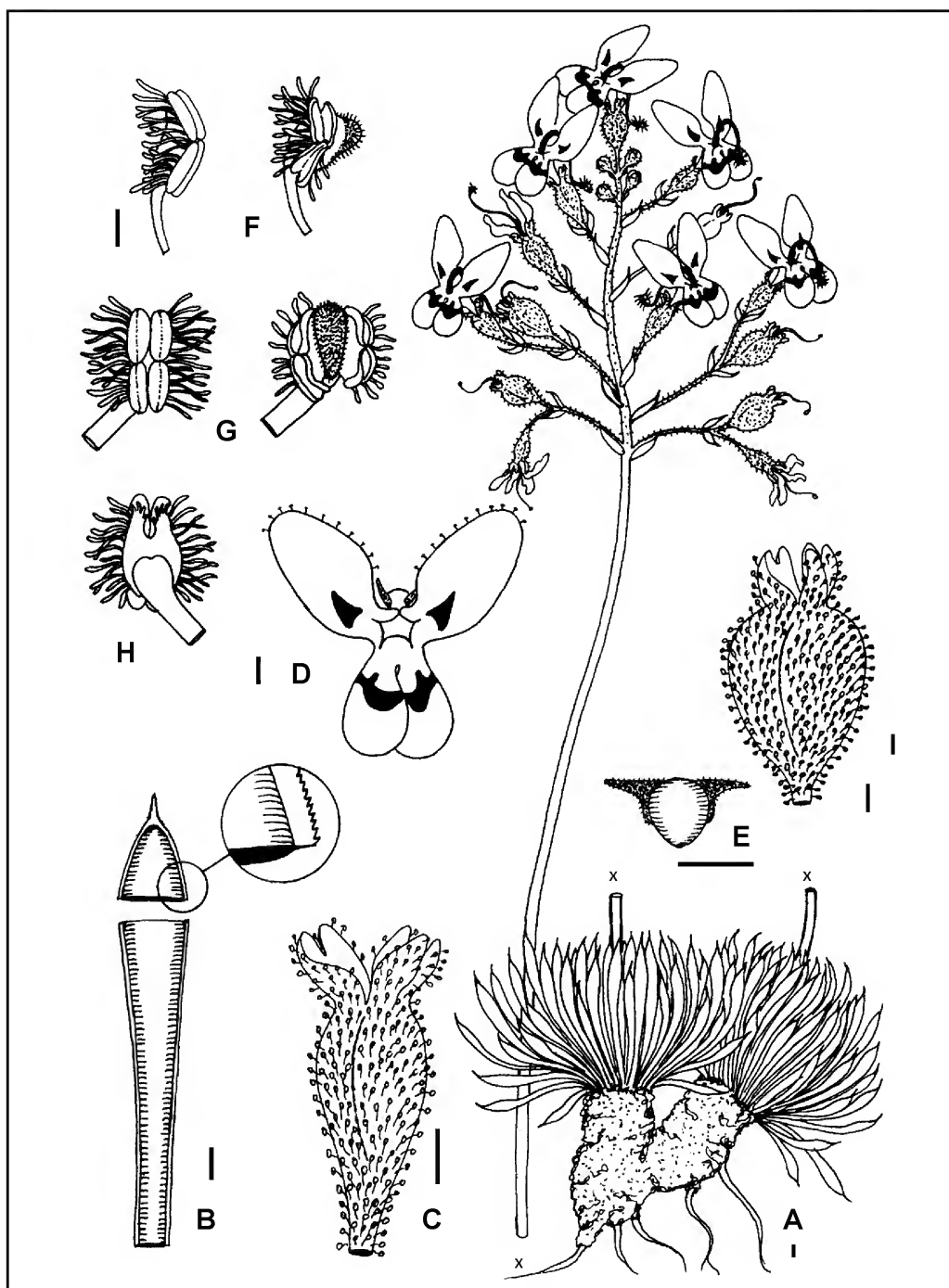


Figure 1. *Styliidium amphora*. A – habit of flowering plants; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with stigma grown out (right); H – abaxial view of gynostemium tip at anther stage; I – seed capsule. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 399.

*Diagnostic features.* *Stylidium amphora* is distinguished from other members of the *S. piliferum* complex by having a yellow corolla with a very long [c. 20 mm] gynostemium; reddish maroon anthers, with long translucent-white moniliform hairs on the margins; stigma gibbose; and a seed capsule that is distinctly broadly obovoid, c. 7 mm long, c. 4.5 wide near its apex and c. 1 mm wide at the base.

*Selected specimens examined.* WESTERN AUSTRALIA: near Newdegate [E of Lake Grace], 7 Nov. 1931, *W.E. Blackall* 1291 (PERTH); Cowcowing, Oct. 1904, *M. Koch* 1215 (PERTH); Karomin Rocks, Nungarin, 13 Oct. 1991, *A. Lowrie* 401 (PERTH); Karomin Road, near Mangowine Homestead, 10 Oct. 1992, *A. Lowrie* 679 (PERTH); Quairading, 20 Oct. 2011, *A. Lowrie* 4209 (PERTH); uncleared privately owned land on C.G. 10492, 1 km NW Mawson Siding, 19 km W Quairading, 8 Sep. 1977, *B.G. Muir* 397 C/W (PERTH).

*Vernacular name.* Amphora Triggerplant (here designated).

*Distribution and habitat.* Occurs in the Avon Wheatbelt in the region bordered by Quairading north 114 km to Cowcowing, east-south-east 70 km to Nungarin, south 246 km to Newdegate and north-west 208 km back to Quairading. Grows in loamy sand on the aprons of granite outcrops as well as in white, sandy soils on heathland. The soil types other collectors have recorded include sandy loam, pale sand, yellow sand, gravel soils, shallow brown loam over granite, and brown clayey sand. The associated vegetation communities too are variably recorded as: *Leptospermum roei* shrubland, sometimes with *Banksia* and *Verticordia*; *Allocasuarina acutivalvis* thickets; *Borya*, mosses, scattered shrubs in granite rock crevices to dwarf shrub places; open heath.

*Flowering period.* September to December.

*Conservation status.* Not threatened.

*Etymology.* The epithet *amphora* is from the Latin *amphora* – amphora, a container shaped in an obovoid form, used in vast numbers for the transport and storage of various products, both liquid and dry, but mostly for wine during the reign of the ancient Roman Empire. The epithet *amphora* is used as a noun in apposition and refers to the hypanthium as well as the seed capsule of this species being of a similar shape to an amphora.

*Affinities.* *Stylidium amphora* is chiefly distinguished from all other members of the *S. piliferum* complex by its distinctly broadly obovoid hypanthium and seed capsule.

In some specimens (e.g. *A. Lowrie* 679, PERTH) of *S. amphora* the posterior corolla lobes are sometimes fused basally, but to a lesser degree than *S. ponticulus* Lowrie & Kenneally. However, in these specimens this bridge-like structure has concavely curved sides between the anterior and posterior lobe bases, whereas in *S. ponticulus*, the bridge between these lobes has distinctively angled, parallel sides, and the posterior lobes are notably very small.

Furthermore, *S. amphora* is distinguished from *S. ponticulus* (whose contrasting morphological characters are given in parenthesis) by having: a very long [c. 20 mm] gynostemium (gynostemium c. 11.5 mm long); anthers reddish maroon (anthers dark maroon); with long, translucent-white, moniliform hairs on the margins (moniliform hairs translucent-red); stigma gibbose (stigma pulviniform).

*Notes.* In the field one of us (AL) has mostly seen yellow-flowered specimens; however, at the type

location a few specimens were found that had cream-coloured flowers. Other collectors have also labelled their herbarium gatherings as having just yellow flowers; however, some collectors record the flower colours of their gatherings as: white; cream with red stripes below and yellow throat; cream or yellow.

**Stylidium bicolor** Lindl., *Sketch Veg. Swan R.*: xxviii (1839); *Stylidium piliferum* var. *bicolor* (Lindl.) Mildbr., in Engl., *Pflanzenr.* (Heft 35): 71 (1908). *Type*: not cited [*vide* J.A. Wege, in sched.: Swan River, 1839, *J. Drummond s.n.*] (*iso*: K 000060741, K 000355199, K 000355200).

*Perennial herb*, 30–40 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 4 tightly clustered rosettes arising from the apices of below-ground branching stems, with their bases adpressed to the soil surface, very old plants branching above the soil surface; leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green on the adaxial surface, abaxial surface pale maroon, linear, incurved, transversely lenticulate in T.S., 2.5–3.5 cm long, 0.6–0.8 mm wide near the base, narrowing just above the base then gradually dilated to 1.2–1.3 mm wide near the apex, *c.* 0.4 mm thick, hyaline margin translucent-white, serrulate, 0.1–0.2 mm wide, apical mucro translucent-white, 2–2.5 mm long. *Scape* glabrous; with 1 or more (generally 3 or 4) scattered bracts similar to the floral bracts. *Inflorescence* mostly racemose, pedicels 4–8 mm long, inflorescence glandular, trichomes translucent-white, 0.2–0.3 mm long, tipped with blackish maroon gland; floral bracts ovate, 2–3 mm long, 0.6–0.8 mm wide, apical mucro translucent-white, 0.5–0.8 mm long, hyaline margin translucent-white, serrulate; bracteoles similar, 1–1.2 mm long, 0.4–0.5 mm wide. *Hypanthium* dark green, narrowly obovoid to narrowly oblong at anthesis, 3–4 mm long, 1.5–2 mm wide, densely glandular, trichomes translucent-white 0.2–0.3 mm long, tipped with blackish maroon glands. *Calyx* with 2 lobes connate almost to their apex, 2.5–3 mm long, 3 lobes free to base, 2.5–3 mm long, moderately glandular, margin hyaline, translucent-white,  $\pm$  entire to a little irregular. *Corolla* white, abaxial surface whitish with reddish lanceolate mid-vein stripes, moderately glandular with scattered translucent-white trichomes tipped with blackish maroon glands; lobes vertically-paired; anterior lobes 4–4.5 mm long, 2.5–3 mm wide, bases yellow with reddish marks; posterior lobes 6–7 mm long, 3–3.5 mm wide, bases yellow with reddish marks. *Labellum* boss pale green, broadly obovate, *c.* 1 mm long, *c.* 1 mm wide, smooth; basal appendages 2, lateral, pale green tinged with red, subulate, *c.* 0.4 mm long, *c.* 0.2 mm wide at the base, papillose; margins red, papillose. *Throat* yellow, appendages absent. *Gynostemium* *c.* 12 mm long, red, torus pale green; anthers blackish maroon, positioned *c.* 45° to the gynostemium; margins with translucent-white moniliform hairs; pollen yellow; stigmas 2, clavate, one projected *c.* 0.7 above the anthers, the other projected *c.* 0.5 mm below. *Capsule* obovoid, *c.* 6 mm long, *c.* 3 mm wide. *Seeds* brown,  $\pm$  ovoid in outline with  $\pm$  angled longitudinal sides, 0.5–0.6 mm long, 0.35–0.4 mm wide, testa mostly smooth with a few scattered minute papillae. (Figure 2)

*Diagnostic features.* *Stylidium bicolor* is distinguished from all other species in the group by having a basal rosette of linear leaves; scape (including inflorescence) 30–40 cm long, with mostly single, alternate flowers along its rachis; corollas white, lobes vertically-paired, abaxial surface whitish with reddish lanceolate mid-vein stripes, anterior and posterior lobe bases yellow with reddish marks.

*Selected specimens examined.* WESTERN AUSTRALIA: Guildford, Perth, Oct. 1901, *C. Andrews s.n.* (PERTH); 15.3 km from Jurien Bay toward Moora; at turnoff Moora-Eneabba road, 24 Sep. 1968, *E.M. Canning* WA/68 3392 (PERTH); 38 km S of the Geraldton Highway turnoff on the Eneabba road, 28 Sep. 1976, *R.J. Chinnock* 3197 (PERTH); Hi Vallee property (D. & J. Williams) Warradarge, southern end of main valley, 23 Oct. 1999, *M. Hislop* 1728 B (PERTH); 5 km S of Eneabba town site,

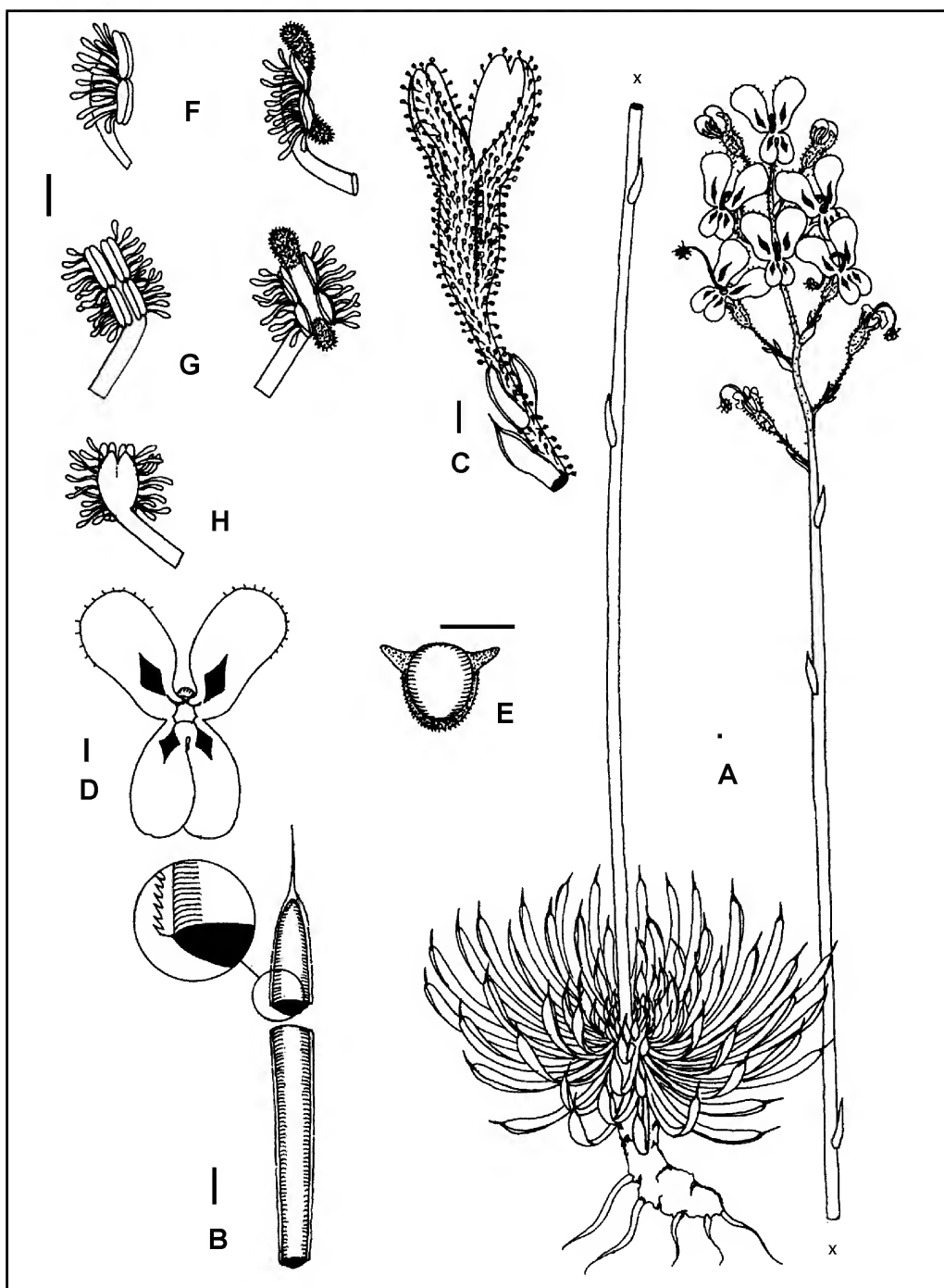


Figure 2. *Stylidium bicolor*. A—habit of flowering plant; B—leaf, and enlarged section (inset); C—hypanthium and calyx lobes; D—corolla; E—labellum; F—lateral view of gynostemium tip showing anthers (left), and with stigmas grown out (right); G—adaxial view of gynostemium tip showing anthers (left), and with stigmas grown out (right); H—abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 413.

11 Nov. 2014, *F. Hort* 21 (PERTH); 4–5 m[iles] S Hill River Bridge on road leaving bitumen road at 9.5 m[iles] E Jurien Bay going S to Cadda Road, Oct. 1971, *S. James* 71.10/35 (PERTH); north-western boundary of the Agriculture Protection Board complex, Bougainvillea Ave, Forrestfield (adj. to plot apbf-2), 24 Sep. 1992, *B.J. Keighery & N. Gibson* 920 (PERTH); 11.2 km N of Arrowsmith River, on the Brand Highway, N of Perth, 17 Oct. 1975, *K.F. Kenneally* 4694 (PERTH); Fynes Nature Reserve, E of Fynes Road, S of Mogumber Road, 7 Nov. 2006, *S. Kern & A. Rea* 12083 (PERTH); on Banovich Road (S end), c. 0.6 km S of creek crossing, Mt Lesueur region, 18 Oct. 1991, *A. Lowrie* 413 (MEL, PERTH); Yeal Nature Reserve, 50 m W from a point 690 m SSW of intersection of track and Airforce Road at 3.57 km W along Airforce Road from intersection with Duffy Road, 1.25 km N along Duffy Road from intersection of Airfield Road and Duffy Road, Gingin South, 14.8 km SW of Gingin, GSS site 9A, 17 Oct. 2008, *D.A. Mickle & M.L. Swinburn* 340 (PERTH); Watheroo National Park, 4 Oct. 1971, *R.D. Royce* 9557 (PERTH); 6.3 km from Brand Highway along Airfield Road, then Duffy Road, Yeal Swamp Nature Reserve, 10 Oct. 2006, *J.A. Wege* 1334 (PERTH); 1.6 km E on Cadda Road from Brand Highway, Badgingarra National Park, 20 Oct. 2009, *J.A. Wege* 1686 & *W.S. Armbruster* (PERTH); at the end of Schofield Road, near Welshpool Road, eastern coastal plain, Perth, 9 Oct. 1998, *J.A. Wege* 507 & *J. Bussell* (PERTH); c. 9.8 km W along Orange Springs Road from Brand Highway, Moore River National Park, 1 Oct. 2004, *J.A. Wege* 1223 & *K.A. Shepherd* (PERTH); 8.65 km N along Cockleshell Gully Road from Jurien East Road, Lesueur National Park, 24 Sep. 1996, *J.A. Wege* 214 & *R. Wiltshire* (PERTH); E of Yardonogo Nature Reserve, Mt Adams Road, c. 30 km S of Dongara, 23 Oct. 2006, *G. Woodman & B. Taylor* D 5 – 2 (PERTH).

*Distribution and habitat.* Swan Coastal Plain north, extending from Welshpool to Arrowsmith River. Grows in: deep white or grey sand in open *Banksia* woodlands as well as low shrubland with scattered emergent mallee and *Nyctisia*; yellow-grey sand in *Banksia* and *Allocasuarina* woodland; white sand over clay colluvium in *Banksia/Acacia/Cycas* [*Macrozamia*] and loam in woodland dominated by *Banksia menziesii*, *B. attenuata* and *Eucalyptus tottiana*; sandy grey soils in low open heath.

*Vernacular name.* Northern Sandplain Triggerplant (here designated).

*Flowering period.* September to November.

*Conservation status.* Reasonably widespread and well-represented within the conservation estate.

*Etymology.* The epithet is from the Latin *bi-* (two-) and *-color* (-coloured), and refers to the corolla colour.

*Affinities.* *Stylidium bicolor* is morphologically similar to *S. ponticulus* because it too typically has a simple raceme inflorescence. *Stylidium bicolor* differs from *S. ponticulus* (whose contrasting characters are given in parenthesis) by having: leaves dull, linear, transversely lenticulate in T.S., mucro 2–2.5 mm long (leaves shiny silvery grey-green, oblanceolate, transversely narrowly obtriangular with a prominent abaxial longitudinal mid-vein in T.S., mucro 1–1.8 mm long); corolla white, abaxial surface whitish with reddish, lanceolate, mid-vein stripes, anterior and posterior lobe bases joined together (corolla white or pink, abaxial surface white, anterior lobes connected to the posterior lobes by a little bridge).

*Notes.* Mildbraed (1908) reduced *S. bicolor* to a variety of *S. piliferum*; however, this species has been recognised in Western Australia since 2006 (Western Australian Herbarium 1998–). *Stylidium bicolor* differs considerably from *S. piliferum* (whose contrasting principal characters are given in parenthesis) by having: linear leaves (leaves oblanceolate); mostly single-flowered pedicels (peduncles

mostly multi-flowered); corolla lobes with yellow and reddish marks near the base (corolla lobes with yellow marks near the base).

***Stylidium bindoon*** Lowrie & Kenneally, *sp. nov.*

*Type*: on the corner of Julimar Road and Plunkett Road, c. 22 km west of Toodyay, Western Australia, 21 September 1991, A. Lowrie 324 (*holo*: PERTH 08702519; *iso*: MEL).

*Stylidium* sp. Bindoon (K.F. Kenneally 11405), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 7–14 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 4 tightly clustered rosettes arising from the apices of below-ground stems and sitting above the ground on stilt roots; leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, incurved, transversely falcate with the abaxial longitudinal mid-vein prominent in T.S., 0.9–1.2 cm long, 0.5–0.6 mm wide near the base, gradually dilating to 0.8–1.2 mm wide near the apex, c. 0.3 mm thick, hyaline margin translucent-white, serrulate, 0.1–0.15 mm wide, apical mucro translucent-white, 3–6 mm long. *Scape* glabrous; bracts absent. *Inflorescence* racemose, densely covered with translucent-yellow non-glandular trichomes c. 0.1 mm long, with a cluster of translucent-white trichomes c. 0.2 mm long each tipped with a blackish maroon gland; pedicels 3–6 mm long; floral bracts ovate, 2–3 mm long, 0.5–0.6 mm wide, mucro translucent-white, 0.7–1.5 mm long, hyaline margin translucent-white, serrulate; bracteoles similar, 1.2–1.5 mm long, 0.2–0.3 mm wide. *Hypanthium* dark green, narrowly oblong at anthesis, 3.5–6 mm long, 0.5–1 mm wide at the base, dilated to 0.9–1.5 mm at the apex, densely covered with non-glandular yellowish trichomes c. 0.1 mm long, with a cluster of translucent-white trichomes c. 0.2 mm long, each tipped with a blackish maroon gland, positioned on the base of the hypanthium and extending onto the pedicel. *Calyx* glabrous, 2 lobes connate almost to their apex, 3 lobes free to their base, 2–3 mm long, margin hyaline, translucent-white, a little irregular and minutely ciliate. *Corolla* pale yellow fading to cream, abaxial surface pale yellow blushed with red along the mid-vein, moderately glandular with scattered translucent-white trichomes tipped with blackish maroon glands; lobes vertically-paired; anterior lobes 5–7 mm long, 2.8–3 mm wide, with yellowish green marks near their base, posterior lobes 7–9 mm long, 2.5–3.5 mm wide, with yellowish green marks near the base. *Labellum* boss pale green, broadly obovate, c. 0.9 mm long, c. 1 mm wide, smooth; basal appendages 2, white, subulate, lateral, c. 0.6 mm long, c. 0.3 mm wide at the base, papillose; margins and apical beard white, irregular, c. 0.1 mm wide, papillose. *Throat* with yellowish green marks only, appendages absent. *Gynostemium* c. 15 mm long, reddish, torosus yellowish green; anthers reddish, positioned c. 45° to the gynostemium; margins with short, translucent, pale red, moniliform hairs; pollen white; stigmas 2, clavate, projected between the spent anthers, the upper one c. 0.7 long, the lower one c. 0.5 mm long. *Capsule* not seen. *Seeds* not seen. (Figure 3)

*Diagnostic features.* *Stylidium bindoon* is distinguished from all other members of the *S. piliferum* complex by having: a basal rosette of oblanceolate leaves; a glandular, narrowly oblong hypanthium with glabrous calyx lobes, with the hypanthium densely covered with non-glandular, yellowish trichomes, with a cluster of translucent, white trichomes c. 0.2 mm long, each tipped with a blackish maroon gland, positioned at the base of the hypanthium and extending onto the pedicel; and a pale yellow (fading to cream) corolla.

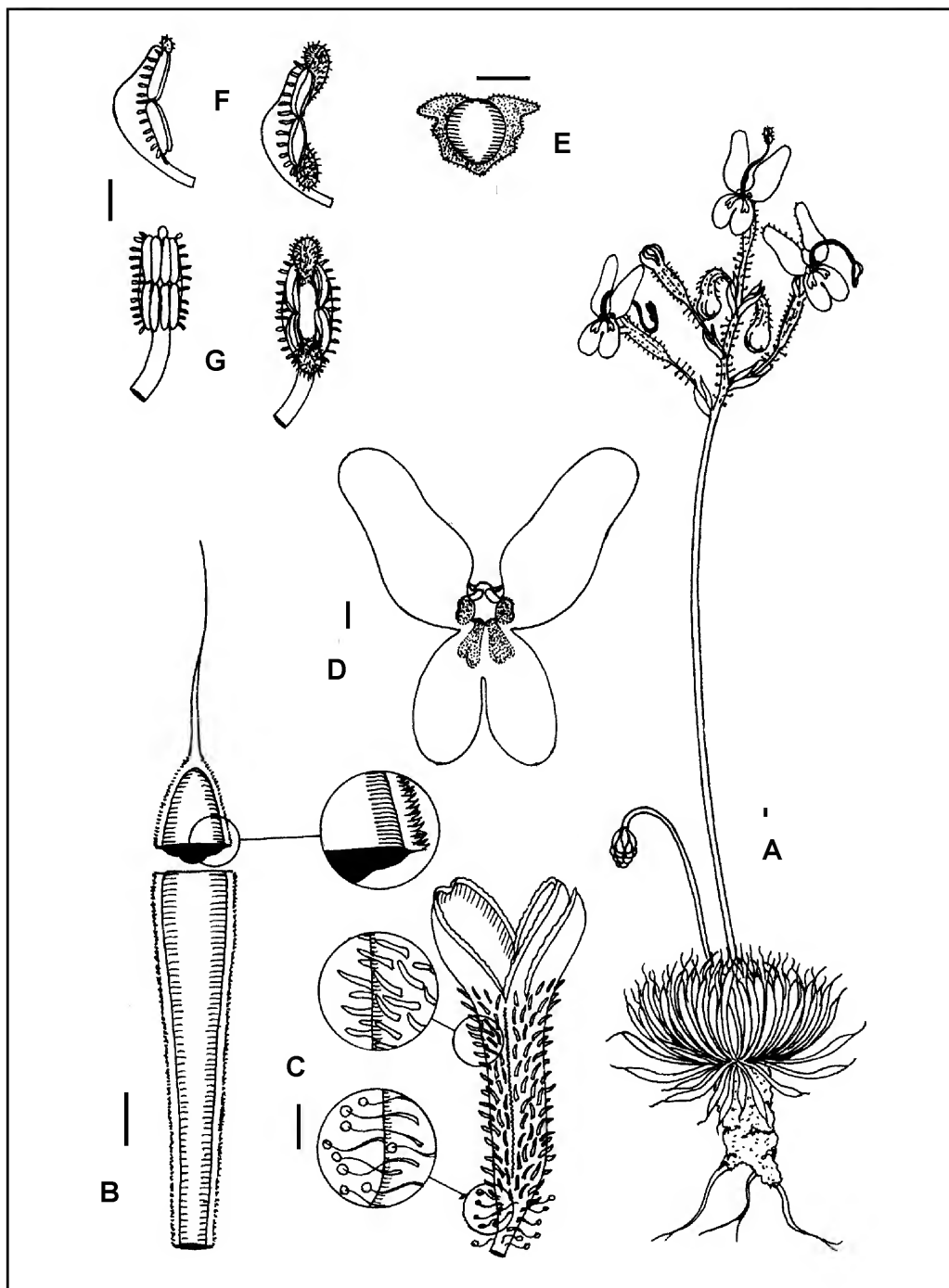


Figure 3. *Styliidium bindoon*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, with indumentum details (insets); D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with the stigmas grown out (right). Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 324.

*Selected specimens examined.* WESTERN AUSTRALIA: 66 mile peg on Geraldton Road [5 km S of Wannamal on the Geraldton Highway], 1 Oct. 1947, *C.A. Gardner* 8652 (PERTH); c. 6 miles S of Toodyay on Toodyay-Perth Road, Sep. 1974, *S. James* 74.9.17 (PERTH); behind Mount Rupert Station, Mount Rupert Estate is 6 km N of the Wongan Hills-Piawanning Road, W of Wongan Hills township, 10 Sep. 1975, *K.F. Kenneally* 4587 (PERTH); track into Julimar Forest, 20 km E of junction of Great Northern Highway and Dewars Pool-Bindoon Road and 17.5 km SW on track into forest, 3 Nov. 1993, *K.F. Kenneally* 11405 (PERTH); on Dewars Pool Road, c. 5 km E of Great Northern Highway, 14 Sep. 1991, *A. Lowrie* 302 (MEL, PERTH); on Dewars Pool-Bindoon Road, c. 7 km E of Great Northern Highway, 14 Sep. 1991, *A. Lowrie* 303 (MEL, PERTH); on Great Northern Highway c. 1.2 km S of Hay Flat Road, 28 Sep. 1991, *A. Lowrie* 334 (MEL, PERTH); on Great Northern Highway in swamp just E of the junction with Rutland Road, Bullsbrook, 2 Oct. 1991, *A. Lowrie* 356 (MEL, PERTH); just N of the entrance of Walyunga National Park W boundary, 2 Oct. 1991, *A. Lowrie* 368 B (MEL, PERTH); transect number: DP15, Dewars Pool Road, c. 21.9 km E of the intersection with Toodyay-Bindi-Bindi Road, 11 Oct. 2000, *B. Morgan* BMor 15 (PERTH); E of Bindoon, 10 Sep. 1952, *A. Notley s.n.* (PERTH); transect number: DP07, Dewars Pool Road, c. 24.1 km E of the intersection with Toodyay-Bindi-Bindi Road, 30 Sep. 2000, *M.E. Trudgen* MET 21,172 (PERTH); rest area c. 7.6 km E on Calingiri-Wongan Hills Road from Great Northern Highway, 9 Oct. 2002, *J.A. Wege* 662 (PERTH); c. 1.2 km E of Railway Road, Clackline Nature Reserve, 5 Oct. 2010, *J.A. Wege* 1781 (PERTH); c. 9 km S of Toodyay on Toodyay Road, 29 Sep. 2002, *J.A. Wege* 657 & *C. Wilkins* (PERTH).

*Vernacular name.* Bindoon Triggerplant (here designated).

*Distribution and habitat.* Occurs on the Swan Coastal Plain, in the Jarrah Forest and north to the Avon Wheatbelt. Grows: along breakaway ridge lines in brown clayey sand over laterite in open wandoos and jarrah woodland with *Banksia sessilis*; in brown gravel, laterite in *Eucalyptus accedens* open woodland with *Banksia squarrosa*; in laterite gravel with open shrubs in open wandoos woodland; in laterite in jarrah and marri open woodland; in grey-brown gritty quartzite sand with *Banksia menziesii* woodlands and heath; in brown loamy sand with fine gravel in *Eucalyptus marginata* woodlands and mixed, low open heath.

*Flowering period.* September to October.

*Conservation status.* Reasonably widespread and well represented within the conservation estate.

*Etymology.* This species is named after the town-site of Bindoon (Latitude 31° 23' S, Longitude 116° 06' E). Bindoon was gazetted in 1953, but the name has been in use in this area for over 150 years. It is derived from the name given by an early settler, Mr William Locke Brockman, to the property he surveyed in 1843. Bindoon is an Aboriginal name, thought to mean 'place where yams grow' (*fide* Landgate 2017). The epithet is formed as a noun in apposition.

*Affinities.* *Stylidium bindoon* is morphologically similar to *S. miniatum* Mildbr. as both species have a glandular hypanthium with glabrous calyx lobes. It differs from *S. miniatum* (whose contrasting characters are given in parenthesis) by having: oblanceolate leaves (leaves linear); a narrowly oblong hypanthium, densely covered with non-glandular, yellowish trichomes c. 0.1 mm long with a cluster of translucent white trichomes c. 0.2 mm long, each tipped with a blackish maroon gland, positioned on the base of the hypanthium and extending onto the pedicel (hypanthium narrowly obovoid, glandular, glandular trichomes ± of similar length arising from the apex of distinctive translucent conical mounds, gland mounds extending onto the pedicel for a short distance).

*Stylidium ferricola* Wege & Keighery also has a glandular hypanthium with glabrous calyx lobes and on present knowledge appears to be a species confined to the Whicher Range east of Busselton some 240 km south of the closest populations of *S. bindoon* near Bullsbrook. While both *S. bindoon* and *S. ferricola* share a narrowly oblong hypanthium, it is densely covered with non-glandular trichomes in the former species (with some glandular trichomes at the base and on the pedicel) and glandular trichomes in the latter.

*Notes.* *Stylidium bindoon* was first discovered growing with *S. semaphorum* Lowrie & Kenneally when one of us (AL) was undertaking a survey of this rare triggerplant in an area referred to generally as the Bindoon region. This species was first discovered south of the small town of Bindoon and accordingly, the epithet *bindoon* has been chosen for this species.

***Stylidium ciliatum*** Lindl., *Sketch Veg. Swan R.* xxviii (1839); *Candollea ciliata* (Lindl.) F. Muell., *Syst. Census Austral. Pl.*: 86 (1882); *Stylidium piliferum* var. *ciliatum* (Lindl.) Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 71 (1908). *Type*: not cited [Swan River, Western Australia, 1835–1838, *J. Drummond s.n.*] (*lecto*, *fide* J.A. Wege, *Nuytsia* 20: 81 (2010): CGE; *isolecto*: CGE, FI 113117, G-DC, K 000060728, M).

*Stylidium setigerum* DC., *Prodr.* 7(2): 782 (late December 1839). *Type*: ‘in Novâ-Hollandiâ ad Swan-river’, [Western Australia, 1835–1838,] *J. Drummond s.n.* (*holo*: G-DC; *iso*: CGE, FI 113117, K 000060728, M).

*Stylidium ciliatum* var. *minor* Sond. [published as  $\beta$  *minor*], in Lehm., *Pl. Preiss.* 1(3): 374 (1845). *Type*: In lapidosis montis Barker vel Bokkenbop, Plantagenet, [Western Australia,] October 1840, *L. Preiss* 2266 (*lecto*, *fide* J.A. Wege, *Nuytsia* 20: 81 (2010): MEL 293336; *isolecto*: G, LD, P 00313119).

*Perennial herb*, 8–40 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons’ growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 20 tightly clustered rosettes arising from the apices of below-ground stems and adpressed to the soil surface, leaves of the present season’s rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, incurved, transversely lenticular with the mid-vein on the abaxial surface prominent in T.S. near the apex, 1.7–3 cm long, 0.6–0.8 mm wide near the base, gradually dilating to 0.7–0.9 mm wide near the centre, dilated to 1.4–1.7 mm wide near the apex, *c.* 0.5 mm thick, margins translucent-white, 0.1–0.3 wide, lower margin serrate, upper margin distinctly ciliate, cilia 0.2–0.3 long, apical mucro translucent-white, hair-like, 3–5 mm long, abaxial surface of leaf lamina near the apex a little scabrous. *Scape* reddish, densely covered from base to apex with a mixture of short and long golden yellow glandular trichomes 0.4–1 mm long; bracts when present oblanceolate, *c.* 4 mm long, *c.* 1 mm wide, hyaline margin translucent-white, ciliate, and bearing an apical mucro *c.* 2 mm long, resembling leaves. *Inflorescence*  $\pm$  paniculate, peduncles 3–6-flowered, peduncles *c.* 8 mm long, pedicels *c.* 4.5 mm long, inflorescence densely covered throughout with a mixture of short and long, golden yellow glandular trichomes; floral bracts green, obovate, 3–5 mm long, 1.3–2 mm wide, hyaline margins absent, margins fringed with a mixture of short and long, golden yellow glandular trichomes, apical mucro translucent-white, 1–1.2 mm long; bracteoles without an apical mucro, otherwise similar to but much smaller than the floral bracts. *Hypanthium* reddish, narrowly obovoid at anthesis, 3–5 mm long, 2–2.2 mm wide, densely covered with a mixture of short and long, golden yellow glandular trichomes 0.3–1 mm long. *Calyx* with 2 lobes connate, 2.5–3.5 mm long, 3 lobes free to their base, 2–3 mm long, densely covered with a mixture of short and long, golden yellow glandular trichomes

similar to those on the hypanthium. *Corolla* lobes cream, abaxial surface cream tinged with yellow, glandular, glands on abaxial surface of corolla golden yellow; lobes vertically-paired, anterior lobes 6–7 mm long, 3.5–4.5 mm wide, with yellow marks near the base; posterior lobes 5–6 mm long, 2.5–3.5 mm wide, with yellow marks near the base. *Labellum* boss yellow,  $\pm$  broadly obovate, c. 0.7 mm long, c. 0.4 mm wide, smooth; basal appendages 2, yellow, wing-like and apically dentate, lateral, c. 0.5 mm long, c. 0.7 mm wide at the base, papillose; margins (including c. 0.4 mm wide triangular apex) with yellow papillae. *Throat* yellow, appendages absent. *Gynostemium* c. 13 mm long, reddish, torus yellow; anthers dark reddish maroon, positioned c. 45° to the gynostemium, c. 2.5 mm long, c. 2.7 mm wide, with translucent-red moniliform hairs along the margins, c. 1 mm long; pollen milky white and vitreous; stigmas 2, obovoid, c. 1 mm long, c. 0.6 mm wide, divaricate. *Capsule* not seen. *Seeds* not seen. (Figure 4)

*Diagnostic features.* *Stylidium ciliatum* is distinguished by having ciliate leaf margins and its entire scape covered with glandular trichomes.

*Selected specimens examined.* WESTERN AUSTRALIA: Telephone Road, near junction with Sonny Road, E of Corbalup Road, 4 Nov. 1997, *A.R. Annels* 5919 (PERTH); edge of Donnelly Plains, N of Manjimup-Bridgetown Road, 1 Nov. 1969, *A.M. Ashby* 3098 (PERTH); 1.7 km SW from Dale Road along power line, 7 Oct. 2003, *R.J. Cranfield* FC 618 (PERTH); Parsons Swamp Road, c. 350 m W of T junction with Whistlers Road, bearing NE, 29 Oct. 1998, *R. Davis* 8528 (PERTH); The Common, Darkan townsite, 3 Oct. 1998, *V. Crowley* 930 (PERTH); Logue Brook Dam Road, c. 1 km E of South Western Highway, 9 km NNE of Harvey, 17 Oct. 1997, *T.R. Lally* 1511 & *B. Fuhrer* (PERTH); on Albany Highway 20.7 km N of Williams, 8 Oct. 1991, *A. Lowrie* 372 (PERTH); Reservoir Road, S of Mundaring Weir, 4 Oct. 2000, *K. Macey* 207 (PERTH); Forest Road, off Crooked Brook Forest, SE of Dardanup, 14 Nov. 2003, *J.A. Wege* 1126 (PERTH); junction of Williamson Road and Claymore Road, SE of Busselton, 2 Nov. 2004, *J.A. Wege* 1253 (PERTH).

*Vernacular name.* Golden Triggerplant (Erickson 1958).

*Distribution and habitat.* Grows in lateritic gravelly soils throughout the Avon Wheatbelt, Jarrah Forest and Swan Coastal Plain bioregions.

*Flowering period.* October to November.

*Conservation status.* Not threatened.

*Chromosome number.*  $n = 14$ , *S. James* 66.10/41 [Oct. 1966] (James 1979).

*Etymology.* The epithet is from the Latin *ciliatus* (fringed with hairs along the margins), and refers to its ciliate leaf margins.

*Affinities.* *Stylidium ciliatum* is a distinctive species, readily distinguished from all other members of the *S. piliferum* complex by its ciliate leaf margins and the entire scape densely covered with a mixture of short and long golden yellow glandular trichomes.

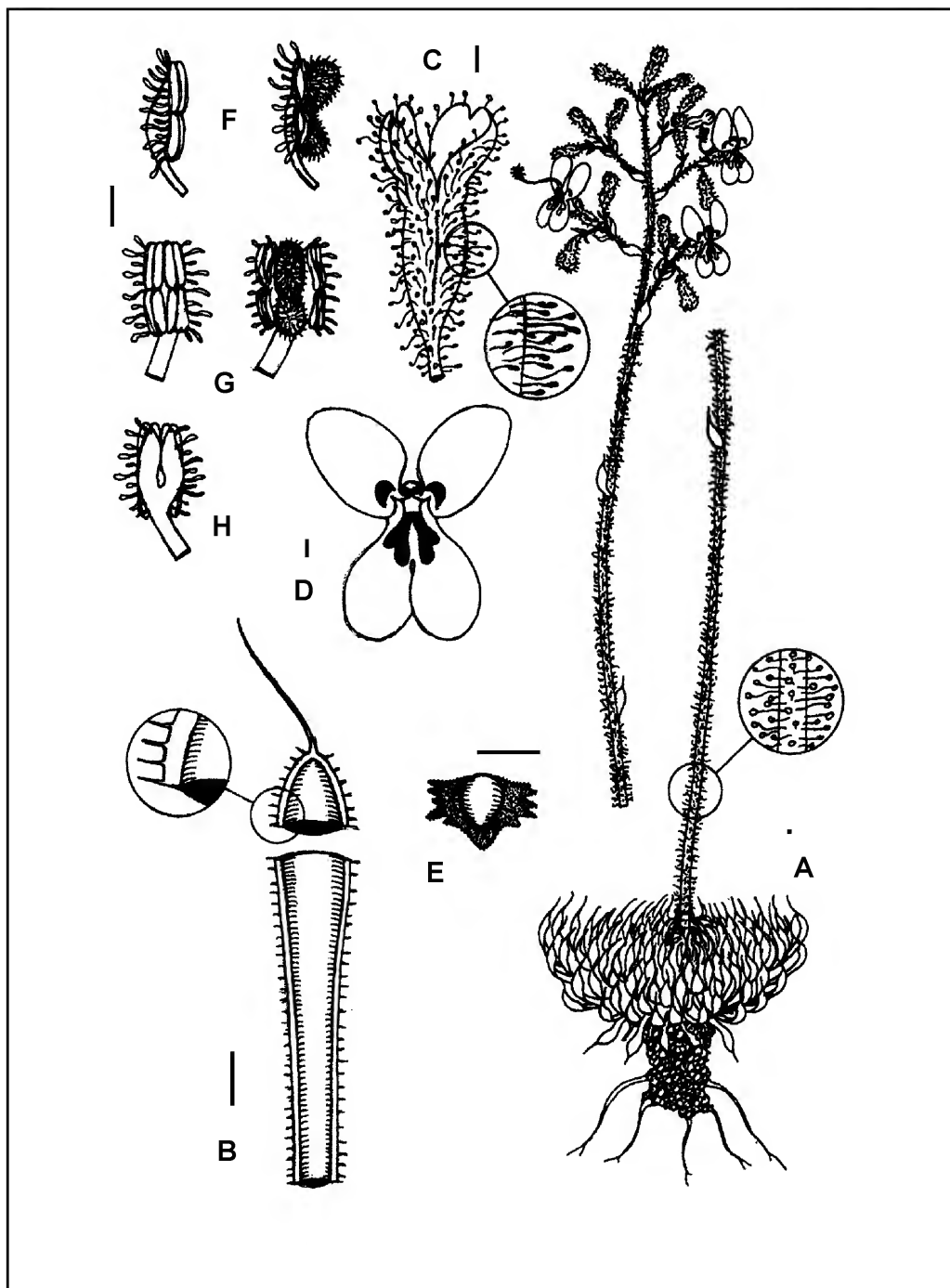


Figure 4. *Stylidium ciliatum*. A – habit of flowering plant with enlarged section of scape (inset); B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, with indumentum detail (inset); D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with stigmas grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 372.

***Stylidium ferricola*** Wege & Keighery, *Nuytsia* 17: 445–452 (2007). *Type*: Whicher Range, Western Australia [locality withheld for conservation reasons], 4 November 1993, *G.J. Keighery* 12932 (*holo*: PERTH 05472148; *iso*: MEL).

*Perennial herb*, 9–15 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 14 tightly clustered rosettes arising from the apices of below-ground stems and adpressed to the soil surface, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, narrowly oblanceolate, slightly incurved towards its apex, transversely narrowly semi-lenticulate in T.S., 10–20 mm long, 1–1.5 mm wide near the base, gradually dilated to 1–1.7 mm wide near the apex, c. 0.2 mm thick, hyaline margin entire, mucro translucent-white, hair-like, c. 4 mm long. *Scape* reddish, distinctly curved and glabrous at its base, becoming glandular towards apex; bracts ovate, 2–4 mm long, margins narrowly hyaline with an apical mucro. *Inflorescence* ± paniculate, 4–40-flowered, peduncles 15–45 mm long, 2–9-flowered, pedicels 3–5 mm long; floral bracts similar to the scape bracts, bracteoles also similar but shorter and narrower. *Hypanthium* reddish, narrowly oblong at anthesis, 3–8 mm long, 0.5–1.2 mm wide, moderately to sparingly glandular. *Calyx* with 2 lobes connate, fused together for more than half their length towards the apex, 1.2–2 mm long, 3 lobes free to their base, 1.2–2 mm long, margin narrowly hyaline. *Corolla* cream with pinkish red apical margin; lobes vertically-paired; anterior lobes c. 7 mm long, c. 1.2 mm wide, with reddish marks at the base surrounded by a lemon yellow zone; posterior lobes c. 5 mm long, c. 1.2 mm wide, with lemon yellow marks only near the base. *Labellum* boss ovate, c. 0.5 mm long, smooth; basal appendages subulate, c. 0.5 mm long, lateral, papillose. *Throat* lemon yellow, appendages absent. *Gynostemium* 9.5–12.5 mm long, reddish, torus lemon yellow; anthers maroon, positioned c. 45° to the gynostemium, without moniliform hairs along the margins; pollen yellow; stigma 1, obovoid, positioned between the upper anthers. *Capsule* not seen. *Seeds* not seen. (Figure 5)

*Diagnostic features.* *Stylidium ferricola* is distinguished by having: a scape which is notably curved outwards from its basal rosette before it ascends vertically; a mostly glabrous scape that only becomes glandular near its apex; a moderately to sparingly glandular, narrowly oblong hypanthium with glabrous calyx lobes, 2 of which are connate and 3 free to their base; and cream corollas with pinkish red apical margins.

*Other specimen examined.* WESTERN AUSTRALIA: [locality withheld for conservation reasons] 11 Nov. 1993, *B.J. Keighery* & *N. Gibson* 623 (PERTH).

*Vernacular name.* Ironstone Triggerplant (here designated).

*Distribution and habitat.* Restricted to the massive ironstones of the Whicher Scarp, adjacent to the Swan Coastal Plain, south of Busselton. Grows in seasonally wet, poorly drained slopes. Shallow red-brown clay loam over ironstone. Recorded from burnt low heath (*G.J. Keighery* 12932) and scrub with *Hakea oldfieldii*, *Dryandra squarrosa* subsp. *argillacea* and *Pericalymma ellipticum* (*B.J. Keighery* & *N. Gibson* 623).

*Flowering period.* Flowering in late October and November.

*Conservation status.* Listed by Smith (2017) as Priority One under Conservation Codes for Western Australian Flora. It is known from two occurrences of a Threatened Ecological Community, both

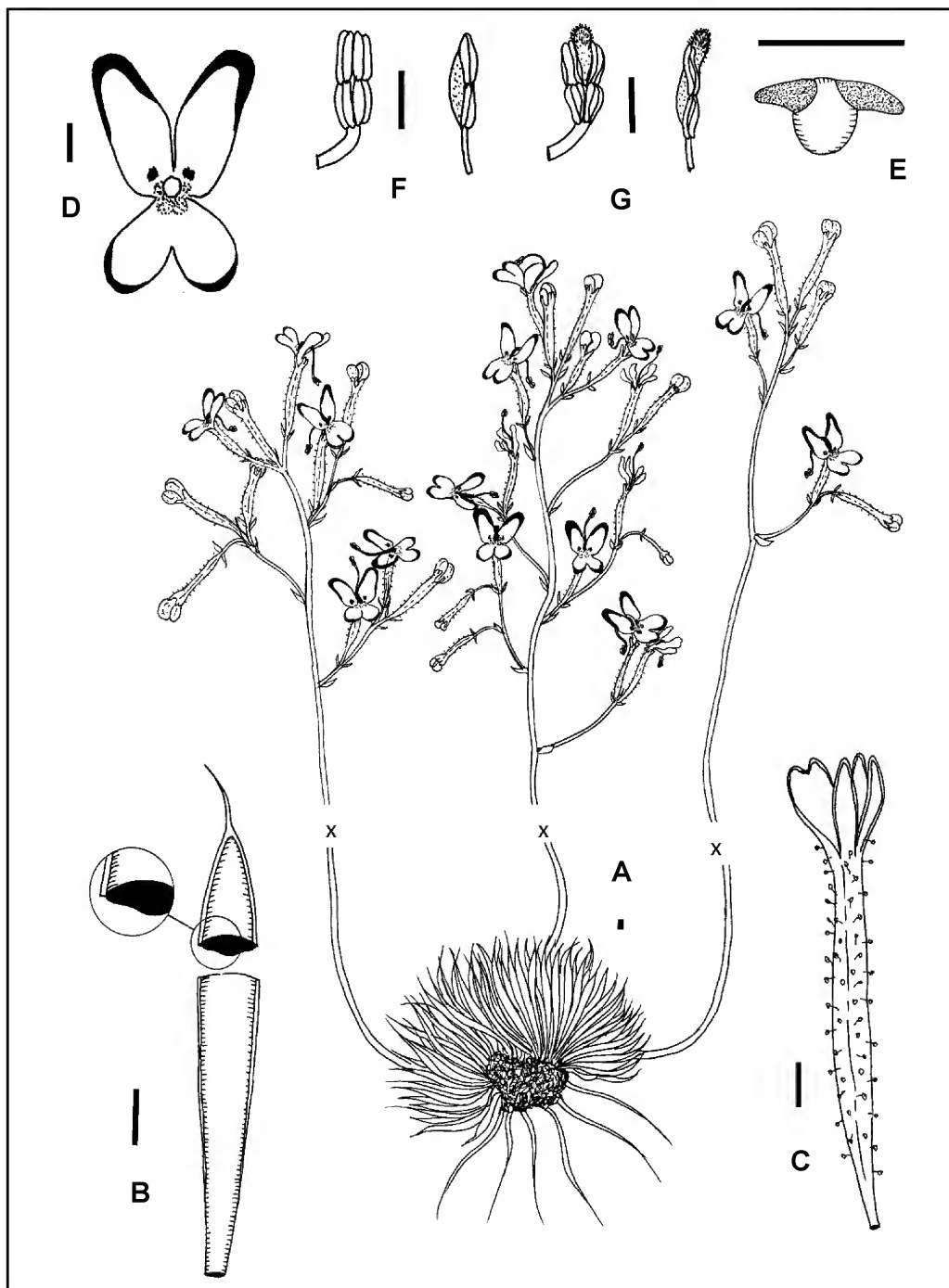


Figure 5. *Stylidium ferricola*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes; D – corolla; E – labellum; F – front view (left) and lateral view (right) of gynostemium tip showing anthers; G – front view (left) and lateral view (right) of gynostemium tip showing stigma grown out at apex. Scale bar = 1 mm. Drawn by Allen Lowrie from G.J. Keighery 12932 (B), B.J. Keighery & N. Gibson 623 (C–G), and a photograph by Greg Keighery (A).

of which are associated with the Whicher Scarp and located within State forest (Wege *et al.* 2007). One of us (AL) has over four seasons tried to locate *S. ferricola* in both of its recorded locations and throughout the Whicher Range without success.

*Etymology.* The epithet is from the Latin *ferrum* (iron) and the suffix *-cola* (inhabiting), and refers to this species' habitat preference.

*Affinities.* *Stylidium ferricola* is morphologically similar to *S. vinosum* Lowrie & Kenneally and *S. strigosum* Lowrie & Kenneally as these species all have an oblong hypanthium and a calyx that has two lobes connate and three lobes free to their base. *Stylidium ferricola* is distinguished from *S. vinosum* and *S. strigosum* in the following triplet:

1. Scapes curved before ascending; hypanthium moderately to sparingly glandular, with calyx lobes glabrous ..... ***S. ferricola***
2. Scapes erect; hypanthium and calyx lobes with dense non-glandular trichomes along with a few scattered glands ..... ***S. vinosum***
3. Scapes erect; hypanthium and calyx lobes with both strigose and straight non-glandular trichomes and sometimes with a few scattered glandular trichomes ..... ***S. strigosum***

***Stylidium hispidum*** Lindl., *Sketch Veg. Swan R.*: xxix (1839). *Type*: not cited [*fide* J.A. Wege, in *sched. Swan River, s. dat., J. Drummond s.n.*] (*iso*: K 000060734, ?K 000060723, ?K 000355146).

*Stylidium hispidum* var. *parviflorum* Sond., in Lehm., *Pl. Preiss.* 1(3): 375 (1845). *Type*: 'In asperis ad radices jugi montium Darling's-range, Perth, Sep. 1841. Herb. Preiss. No. 2270.' (*n.v.*).

*Perennial herb*, 12–28 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 1 to 8 tightly clustered rosettes arising from the apices of below-ground stems, raised above the soil surface on stilt roots, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, tinged with pale maroon, linear, incurved, transversely narrowly elliptic with a prominently ciliate abaxial longitudinal ridge in T.S., 1.5–3 cm long, 0.4–0.5 mm wide near the base, gradually dilating to 0.7–1.3 mm wide near the centre then tapering to the apex, c. 0.6 mm thick, margins above the base distinctly hispid, each stiff hair 0.3–0.5 mm long and well-spaced from its neighbours, apical mucro translucent-white, hair-like, 5–7 mm long. *Scape* reddish, glabrous in its lower 2/3, then gradually becoming densely covered in a mixture of short and long, golden yellow, glandular trichomes; bracts absent. *Inflorescence* ± racemose when single-flowered, ± paniculate when flowers in groups of 2 or 3, peduncles 6–10 mm long, pedicels 3–8 mm long, inflorescence densely covered in a mixture of short and long, golden yellow, glandular trichomes 0.2–0.4 mm long; floral bracts green, obovate, 2–2.5 mm long, 0.4–0.8 mm wide, margins not hyaline, fringed with a mixture of short and long, golden yellow, glandular trichomes, apical mucro translucent-white, 1–1.5 mm long; bracteoles similar but much smaller than the floral bracts. *Hypanthium* green and reddish, narrowly obovoid at anthesis, 3.5–4 mm long, 1.4–1.5 mm wide, indumentum similar to that on inflorescence. *Calyx* with 2 lobes connate, 3–3.5 mm long, 3 lobes free to their base, 3–3.5 mm long, margins scarcely or not hyaline, entire, adaxial surface indumentum similar to that on the hypanthium. *Corolla* creamy white, abaxial surface creamy white, glandular; glands golden yellow; lobes vertically-paired; anterior lobes 8–9 mm long, 3.8–4 mm wide, with

greenish yellow marks near the base, upper margins bearing golden yellow glands; posterior lobes 6.5–7 mm long, 3–3.5 mm wide, with greenish yellow smudges around small reddish marks near the base. *Labellum* boss yellow,  $\pm$  orbicular, c. 0.1 mm long, c. 0.9 mm wide, smooth; basal appendages yellow, triangular, lateral, c. 0.5 mm long and wide; margins irregularly wavy, papillose, c. 0.2 mm wide. *Throat* greenish yellow, appendages absent. *Gynostemium* c. 18 mm long, reddish, torus greenish yellow; anthers dark reddish maroon, positioned c. 45° to the gynostemium, c. 3 mm long, c. 1.5 mm wide; with translucent-red moniliform hairs along the margins, c. 0.2 mm long; pollen yellow, vitreous; stigma 1, obovoid and projected above the anthers before anthesis, stigma after anthesis clavate, elongating and reflexing, c. 1.2 mm long, c. 0.5 mm wide when mature. *Capsule* not seen. *Seeds* not seen. (Figure 6)

*Diagnostic features.* *Stylidium hispidum* is distinguished from all other members of the *S. piliferum* complex by having: leaf margins distinctly hispid, the abaxial longitudinal ridge densely ciliate; the scape glabrous in its lower two-thirds before becoming densely covered with a mixture of short and long, golden yellow, glandular trichomes in its upper parts and throughout its inflorescence.

*Selected specimens examined.* WESTERN AUSTRALIA: Red Hill-Toodyay Road, 18 Sep. 1956, *A.M. Baird s.n.* (PERTH); Ellis Brook Valley Reserve, 18 Sep. 1999, *H. Bowler* 378 (PERTH); 35 mile peg between Bindoon and Bullsbrook, Northern Highway [c. 1 km NE of Muchea on Great Northern Highway], 13 Sep. 1967, *S. Carlquist* 3120 (PERTH); Gorrie Road, 5.5 km SSE of Chidlow, 1 Nov. 1996, *R. Davis* 1574 (PERTH); Kalamunda, 5 Oct. 1951, *R. Erickson s.n.* (PERTH); Fairbridge Farm School, Pinjarra, 25 Aug. 1941, *C.A. Gardner s.n.* (PERTH); E of Churchman's Brook Reservoir, 11 Oct. 1976, *A.M. George* 126 (PERTH); Darlington, Oct. 1973, *S. James* 73.10/15 (PERTH); Darlington scarp, 8 Sep. 1966, *K.F. Kenneally s.n.* (PERTH); on Reserve Road, Muchea, 1 Oct. 1988, *A. Lowrie* 01 (PERTH); The Lakes, 9 Oct. 1988, *A. Lowrie s.n.* (PERTH); on Red Gully Road, c. 18 km E of Brand Highway, 20 Oct. 1989, *A. Lowrie s.n.* (PERTH); 8.3 km E along Kingsley Drive from South West Highway, 6 Nov. 2003, *J.A. Wege* 1086 (PERTH); 6.65 km NW of Williams Road on Del Park Road, NW of Dwellingup, 2 Nov. 2006, *J.A. Wege* 1397 & *B.P. Miller* (PERTH); 600 m N along Nettleton Road from Jarrahdale Road, 24 Oct. 1996, *J.A. Wege* 278 & *J.A. Wege Snr* (PERTH).

*Vernacular name.* White Butterfly Triggerplant (Erickson 1958).

*Distribution and habitat.* Widespread throughout the Jarrah Forest on lateritic gravelly soils.

*Flowering period.* August to November.

*Conservation status.* Reasonably widespread and well-represented within the conservation estate.

*Chromosome number.*  $n = 14$  *vide* *S. James* UWA 1295 Sep. 1971 (James 1979).

*Etymology.* The epithet is from the Latin *hispidus* (having short stiff hairs), and refers to the leaf margins which are distinctly hispid with each well-spaced hair 0.3–0.5 mm long.

*Affinities.* *Stylidium hispidum* is morphologically similar to *S. ciliatum* as both species have fringed leaf margins. *Stylidium hispidum* differs from *S. ciliatum* (whose contrasting characters are given in parenthesis) by having: upper leaf margins distinctly hispid (margins ciliate); a glabrous scape in its lower two thirds and glandular in its upper parts (entire scape glandular).

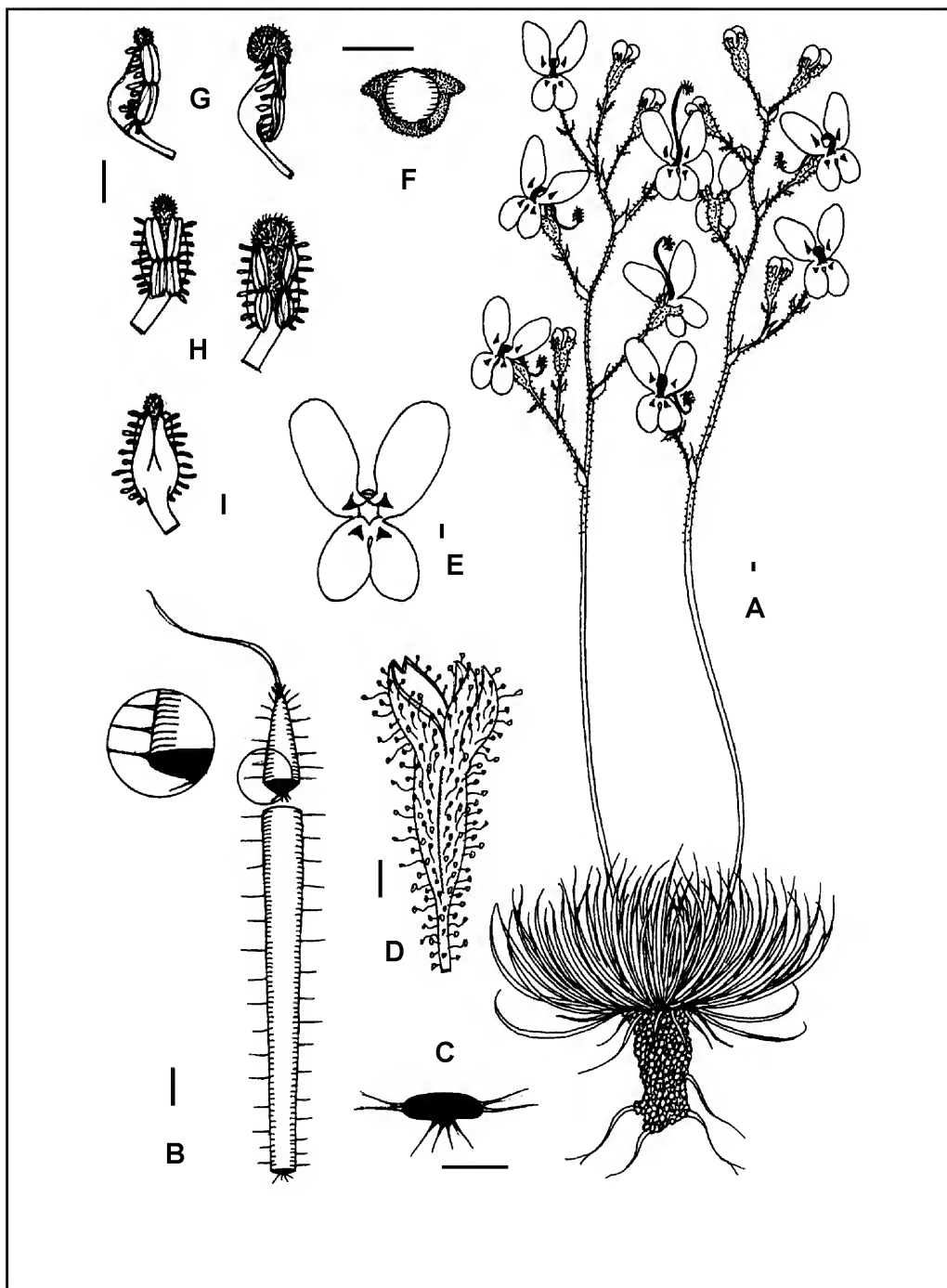


Figure 6. *Stylidium hispidum*. A – habit of flowering plants; B – leaf, and enlarged section (inset); C – leaf, transverse section showing indumentum position; D – hypanthium and calyx lobes; E – corolla; F – labellum; G – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); H – adaxial view of gynostemium tip showing anthers (left), and with stigma grown out (right); I – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie s.n. (PERTH 08702438).

*Notes.* The juvenile stigma of *S. hispidum* is present between the upper pair of anthers well-before anther dehiscence. When the pollen is finally spent, the stigma develops further by increasing its overall size, growing longer and bending backwards over the apex of the spent anthers when mature.

**Stylidium miniatum** Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 69–70 (1908). *Type:* In fruticetis Moore River, August 1901, *E. Pritzel* 581 (*lecto, fide* J.A. Wege, *Nyctisia* 20: 85 (2010): W; *isolecto:* BM, E, G, K 000355138, M, NSW, P, PERTH 01641565). *Paralecto* [residual syntypes]: Moore River östlich bei Mogumber zwischen Gebüsch auf lehmigkeisigem Boden ca. 175 m ü. M., August 1901, *L. Diels* 4031 (B, *n.v.*, destroyed in WWII); Western Australia, *s. dat.*, *J. Drummond* 277 (BM, CGE, E, G, K 000060915, K 000060917, LD, MEL 2295036, W); Distr. Avon: Melbourne, *s. dat.*, *K.A.A. von Hügel s.n.* (B, *n.v.*, destroyed in WWII).

*Perennial herb*, 12–28 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 1 or more clustered rosettes arising from the apices of below-ground stems, raised above the soil surface on stilt roots, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, linear, incurved, transversely cuneate in T.S., 1.5–2.5 cm long, 0.4–0.5 mm wide near the base, 0.7–0.8 mm wide near the apex, *c.* 0.5 mm thick, hyaline margin and mid-vein on abaxial surface translucent-white, serrulate, apical mucro translucent-white, 1–3 mm long. *Scape* glabrous; bract(s) similar to the floral bracts sometimes present in the upper parts. *Inflorescence* racemose, often paniculate in the lower parts, inflorescence glandular, glandular trichomes  $\pm$  of similar length, peduncles 1–3-flowered, the basal peduncles and pedicels 4–10 mm long, the upper ones shorter; floral bracts linear, 2–4.5 mm long, apical mucro and hyaline margin translucent-white, margin serrulate with the apex of the serrations irregularly shortly ciliate; bracteoles similar, 1–2 mm long. *Hypanthium* narrowly obovoid at anthesis, 3.5–5 mm long, 0.7–1.5 mm wide, glandular, glandular trichomes  $\pm$  of similar length, arising from the apex of distinctive, translucent, conical mounds, gland mounds extending onto the pedicel for a short distance. *Calyx* glabrous, sometimes with scattered glands at their base, 2 connate almost to their apex, 3 free to base, 2–3 mm long, hyaline margin translucent-white, edges serrulate with the apices of the serrations very shortly and irregularly ciliate, some cilia bearing a glandular tip. *Corolla* salmon-pink (R.H.S. Orange-Red 33D), abaxial surface salmon-pink with scattered white trichomes bearing red apical glands; lobes vertically-paired; anterior lobes 5–6 mm long, 1.5–3 mm wide, with dark pink marks near the base; posterior lobes 4–4.5 mm long, 1.3–2.5 mm wide, with dark pink marks near the base. *Labellum* boss greenish yellow, obovate, *c.* 1 mm long, *c.* 0.8 mm wide, smooth; basal appendages, white, subulate, lateral, *c.* 0.5 mm long, papillose; margins narrow, irregular, white with the apex a little reddish, papillose, with a few white trichomes bearing red apical glands scattered along the edges. *Throat* greenish yellow, appendages absent. *Gynostemium* *c.* 14 mm long, reddish, torus yellowish green; anthers beige, positioned *c.* 45° to the gynostemium; with reddish moniliform hairs along the margins; pollen white; juvenile stigmas obovoid and present between the upper and lower anther pairs when anthers are shedding pollen (see notes below), stigmas 2, pyriform, extending beyond the spent-anther pairs. *Capsule* not seen. *Seeds* not seen. (Figure 7)

*Diagnostic features.* *Stylidium miniatum* is distinguished from all members of the *S. piliferum* complex by its hypanthium bearing glands arising from the apex of distinctive, translucent, conical mounds.

*Selected specimens examined.* WESTERN AUSTRALIA: opposite Bundarra Nature Reserve, corner of Gillingarra and Capitela Roads, Gillingarra, 4 Oct. 2006, *C. Danese & D. Rayner* B 1006-20 (PERTH); Melbourne District: Moore River, Aug. 1901, *Dr Diels & Pritzel s.n.* (PERTH); Cataby

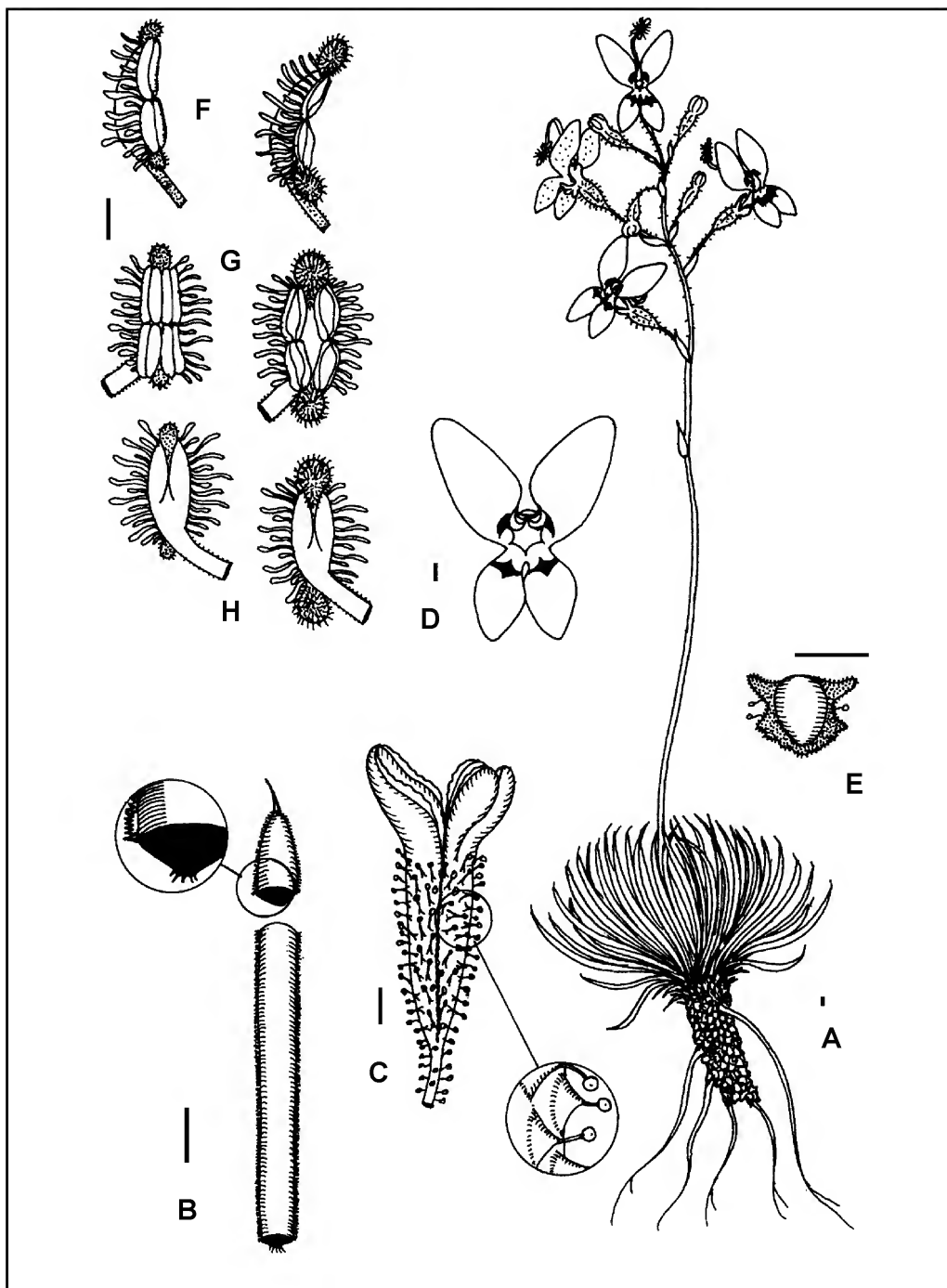


Figure 7. *Stylidium miniatum*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, with indumentum detail (inset); D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers and juvenile stigmas (left), and with the stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers and juvenile stigmas (left), and with the stigmas grown out (right); H – abaxial view of gynostemium tip at anther stage (left), and with the stigmas grown out (right). Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie s.n. (PERTH 08702586).

Roadhouse on Great Northern Highway, 163 km N of Perth, 16 Sep. 1993, *D.J. Edinger* 849 (PERTH); W of Wyening, 23 Sep. 1951, *R. Erickson s.n.* (PERTH); W of Bolgart, Oct. 1952, *R. Erickson s.n.* (PERTH); 5–6 m[iles] [8–9.6 km] S of New Norcia, 1 Oct. 1947, *C.A. Gardner* 8671 (PERTH); Hi Vallee property (D. & J. Williams) Warradarge, track along E side of main valley, 13 Sep. 1999, *M. Hislop* 1515 (PERTH); site 153. P. Toster and P. Phillips property, W side of Coalara Road, c. 1 km of Boothendarra Road, NW of Watheroo, 22 Sep. 2005, *M. Hislop & M. Griffiths* WW 153 – 30 (PERTH); SE of Coomallo Creek pumping station, 10 Aug. 1977, *R.J. Hnatiuk* 770728 (PERTH); outside Gingin Cemetery, Sep. 1971, *S. James* 71.9/64 (PERTH); quadrat WMA18. Tathra National Park. A 29805. Shire of Carnamah. Garibaldi Road, 28 Sep. 1999, *M.A. Langley* 2037 & *P.M. Smith* (PERTH); 0.6 km S of Gillingarra, 18 Sep. 1990, *A. Lowrie s.n.* (PERTH); Wannamal West Road, c. 4 km E of Brand Highway, 5 Oct. 1990, *A. Lowrie* 158 (PERTH); site no. CAH003. Cairn Hill Westrail Reserve, c. 11 km N of Moora on the Midlands Road. The plot is on the E side of track to the radio tower towards the top of the hill, c. 700 m along the track from the Midlands Road, 23 Oct. 2000, *M. Trudgen* 21221 (PERTH); adjacent to the Kolburn Water Treatment Plant, W of Moora on the Dandaragan Road, 17 Sep. 2002, *M.E. Trudgen* 21591 (PERTH); 300 m SW on Fynes Road from Mogumber West Road, 20 Oct. 2011, *J.A. Wege* 1870 (PERTH); 1.75 km N of Coorow-Green Head Road on Brand Highway, 14 Sep. 1996, *J.A. Wege* 208 & *K. Shepherd* (PERTH).

*Vernacular name.* Pink Butterfly Triggerplant (Erickson 1958).

*Distribution and habitat.* Occurs on the Swan Coastal Plain north of Gingin, extending into the Avon Wheatbelt. Grows: on hill crests in lateritic soils in low heath with scattered emergent *Hakea*; hilltops in white-grey sand-gravel over laterite-boulder in heath with scattered marri; on low lateritic hillsides often on firebreaks in species-rich low closed heath with emergent *Eucalyptus gittinsii*, *Xanthorrhoea drummondii*, *Calothamnus sanguineus*, *Isopogon adenanthoides* and *Hakea conchifolia*; on massive laterite mesa tops in dark grey, shallow sand in pockets and crevices with heath; on lateritic upland in orangey brown rocky clayey sand with *Eucalyptus* sp. dominant woodlands.

*Flowering period.* September to October.

*Conservation status.* Reasonably widespread and well-represented within the conservation estate.

*Etymology.* The epithet is from the Latin *miniatus* (saturn-red, ‘painted with red lead’) which may refer to the salmon colour of the corolla markings and not the corolla colour.

*Affinities.* *Stylidium miniatum* is morphologically similar to *S. bindoon* and *S. ferricola* as these three species have hypanthium indumentum and glabrous calyx lobes. *Stylidium miniatum* differs from <sup>1</sup>*S. bindoon* and <sup>2</sup>*S. ferricola* whose contrasting characters are given in parenthesis by having: an obovoid hypanthium (<sup>1</sup> & <sup>2</sup> narrowly oblong); hypanthium with glands arising from conical mounds (<sup>1</sup>densely covered with non-glandular trichomes; <sup>2</sup>moderately to sparingly glandular).

*Notes.* The juvenile stigmas are present between the upper and lower anther pairs when anthers are still shedding pollen. By the time the anthers are spent, the stigmas have developed well-beyond the anther pairs. It is not known if the stigmas are receptive to their own or other clones’ pollen during the period pollen is being shed.

***Stylidium monticola* Lowrie & Kenneally, sp. nov.**

*Type:* Stirling Range, Western Australia [precise locality withheld for conservation reasons], 4 November 2008 [specimens collected 5 October 2008, grown on to flower in cultivation], *A. Lowrie* 3948, *R. Numm* & *G. Bourke* (*holo:* PERTH 08702489; *iso:* MEL).

*Stylidium* sp. Bluff Knoll (S. Barrett s.n. 8/11/1994). Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 3.5–5 cm tall, with basin-like rosettes of regularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants solitary from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 35 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green on adaxial surface, pale maroon on abaxial surface, oblanceolate, mostly flat, slightly incurved near apex, transversely narrowly lenticulate in T.S., 9–10 mm long, 0.3–0.4 mm wide near the base, gradually dilating to 0.6–1 mm wide near the apex, *c.* 0.2 mm thick, margin hyaline, irregularly serrulate, apical mucro translucent-white, hair-like, 0.8–1 mm long. *Scape* reddish, glabrous; bracts absent. *Inflorescence* solitary or racemose, racemes up to 3-flowered, pedicels bearing glandular trichomes between the bracteoles and hypanthium, otherwise glabrous; floral bracts green, narrowly ovate, 1.8–2 mm long, 0.3–0.4 mm wide, apical mucro 0.4–0.5 mm long, margin hyaline  $\pm$  entire; bracteoles similar to but much smaller than the floral bracts. *Hypanthium* green and red, mostly all reddish, narrowly obovoid at anthesis, 3.5–4 mm long, 1–1.5 mm wide, glabrous. *Calyx* margins hyaline, entire, lobes glabrous, sometimes bearing a tiny apical mucro, 2 lobes connate, fused together almost to their apex, 1.2–1.5 mm long, 3 lobes free to their base, 1.2–1.5 mm long. *Corolla* white and pale to dark pink, abaxial surface pale pink with a faint red mid-vein near base, glandular; lobes vertically-paired; anterior lobes 4.5–5 mm long, 2–2.5 mm wide, with lemon yellow marks near the base, apices entire; posterior lobes 4–4.5 mm long, 2–2.3 mm wide, with lemon yellow marks near the base. *Labellum* boss green,  $\pm$  elliptical, *c.* 0.7 mm long, *c.* 0.4 mm wide, smooth; basal appendages reddish, lateral, subulate, *c.* 0.7 mm long, *c.* 0.25 wide at the base; apex with a reddish papillose margin. *Throat* lemon yellow, appendages absent. *Gynostemium* *c.* 9 mm long, green and reddish, torous lemon yellow; anthers maroon, positioned *c.* 45° to the gynostemium, *c.* 2.2 mm long, *c.* 1 mm wide; with translucent-white moniliform hairs *c.* 0.3 mm long along the margins; pollen cream; stigma 1, pulviniform and positioned between the spent vertical anthers, *c.* 0.5 mm diam. and projected forwards *c.* 0.6 mm when mature. *Capsule* not seen. *Seeds* not seen. (Figure 8)

*Diagnostic features.* *Stylidium monticola* is distinguished from other members of the *S. piliferum* complex by its 1–3-flowered inflorescence on scapes 3.5–5 cm long; glabrous hypanthium and calyx lobes; pedicels bearing glandular trichomes between the bracteoles and hypanthium, otherwise glabrous.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] *s. dat.*, *Anonymous s.n.* (PERTH 03172554); 8 Nov. 1994, *S. Barrett s.n.* (PERTH 04245997).

*Vernacular name.* Stirling Range Triggerplant (here designated).

*Distribution and habitat.* Known from locations in the Stirling Range in Western Australia. Grows in grey sandy clay with sandstone quartzite shard rubble with *Astartea fascicularis*, *Taxandria marginata*, and *T. linearifolia*.

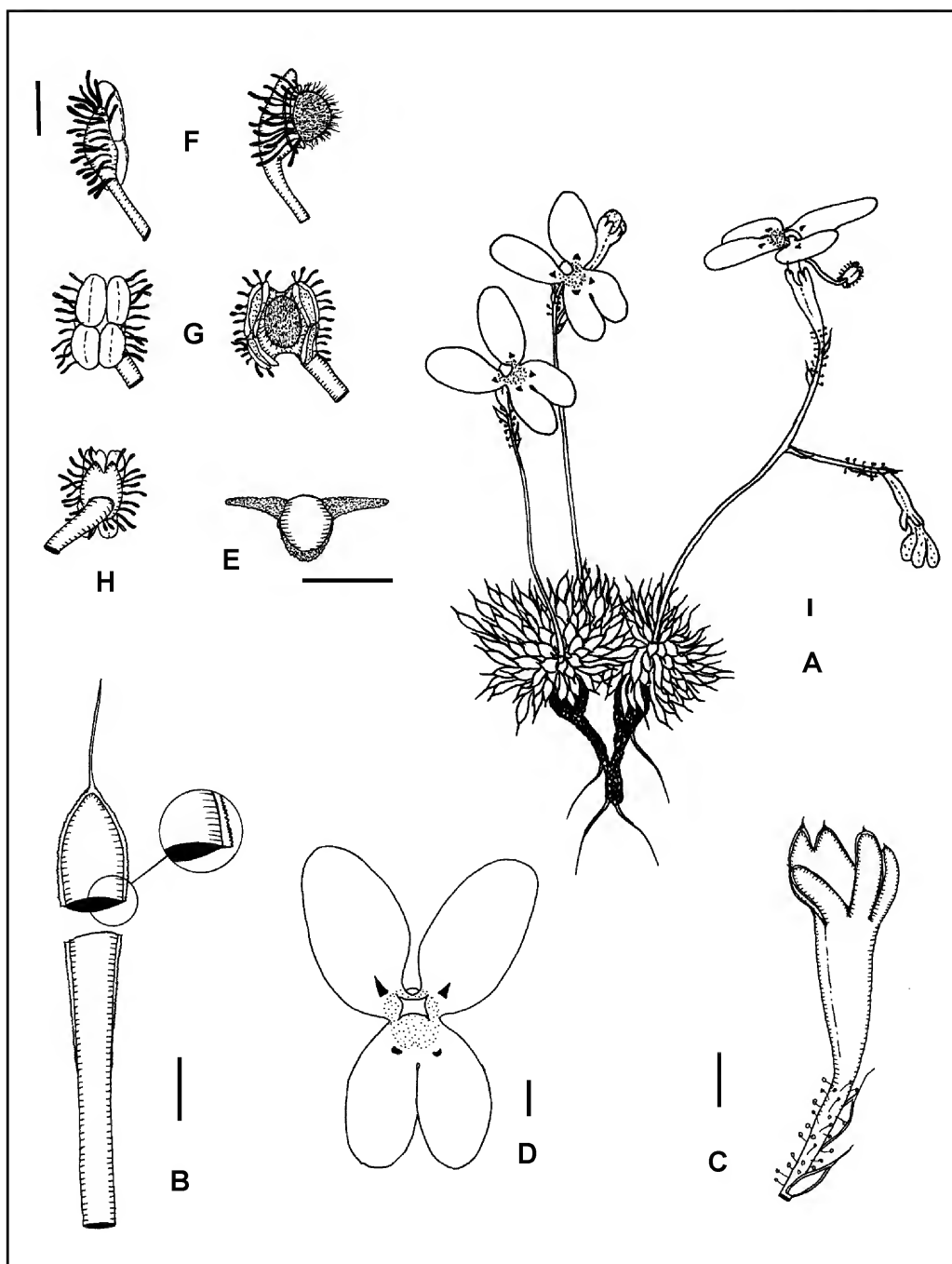


Figure 8. *Stylidium monticola*. A – habit of flowering plants; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, and glandular hairs in region of mucronate bracteoles; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with stigma grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 3948, R. Nunn & G. Bourke.

*Flowering period.* November.

*Conservation status.* Listed by Smith (2017) as Priority Two under Conservation Codes for Western Australian Flora, under the name *Stylidium* sp. Bluff Knoll (S. Barrett s.n. 8/11/1994), due to its restricted, but reserved, occurrence.

*Etymology.* The epithet is from the Latin *monti-* (mountain-) and the suffix *-cola* (-dweller), in reference to this species' habitat, which is restricted to the summits of the Stirling Range.

*Affinities.* *Stylidium monticola* is morphologically similar to *S. nitidum* Lowrie & Kenneally as both species have a glabrous, narrowly obovoid hypanthium and glabrous calyx lobes. *Stylidium monticola* is distinguished from *S. nitidum* by having glandular upper pedicels, whereas the pedicels of *S. nitidum* are completely glabrous.

*Notes.* Although *S. monticola* is the smallest species within the *S. piliferum* complex it is shown to be one of the hardiest species in the complex. At the time of collection for the type material (5 October 2008) the day was extremely cold and snowing.

***Stylidium nitidum*** Lowrie & Kenneally, *sp. nov.*

*Type:* Milyeannup State Forest, Jalbarragup, Western Australia [precise locality withheld for conservation reasons], 23 November 2007, A. Lowrie 3736 & G. Graham (*holo:* PERTH 08702497; *iso:* MEL).

*Stylidium* sp. Glabrous inflorescence (R. Davis 7917), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 18–28 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants solitary from an unbranched stem, with the base adpressed to the soil; older plants comprising 3 to 14 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green on adaxial surface, maroon on abaxial surface, oblanceolate, mostly flat, slightly incurved near apex, transversely narrowly lenticulate in T.S., 7–9 mm long, 0.5–0.6 mm wide near the base, gradually dilating to 1–1.5 mm wide near the apex, c. 0.4 mm thick, margins hyaline, irregularly serrulate, mucro translucent-white, hair-like, 3.5–4 mm long. *Scape* reddish, glabrous; a single narrowly ovate bract, 2.5–3 mm long, 0.6–0.8 mm wide with a translucent-white, ± entire, hyaline margin as well as an apical mucro 2.5–3 mm long, is sometimes present. *Inflorescence* racemose, glabrous, pedicels 4–17 mm long; floral bracts green, similar in shape and size to the bracts on the scape; bracteoles similar to but much smaller than the floral bracts. *Hypanthium* green, green and red or reddish, narrowly obovoid at anthesis, 3–3.5 mm long, 1.2–1.4 mm wide, glabrous, shining. *Calyx* with 2 lobes connate, fused together to within c. 0.5 mm of their apex, 2.8–3 mm long, 3 lobes free to their base, 2.8–3 mm long, glabrous, shining, similar to the hypanthium, margins translucent-white, hyaline entire. *Corolla* cream, abaxial surface creamy yellow with a faint red mid-vein near base, sparsely glandular; lobes vertically-paired; anterior lobes 6.5–8.5 mm long, 2–2.7 mm wide, with lemon yellow markings near the base; posterior lobes 5–6 mm long, 1.7–2.3 mm wide, with lemon yellow markings near the base. *Labellum* boss yellow, ± orbicular, c. 0.8 mm diam., smooth, basal appendages yellow, lateral, subulate, c. 0.3 mm long, c. 0.3 wide at the base; apical margins reddish, papillose, with a few glands. *Throat* lemon yellow, appendages absent. *Gynostemium* c. 12 mm long,

pale green with reddish margins, torus lemon yellow; anthers reddish maroon, positioned c. 45° to the gynostemium, c. 2 mm long, c. 0.8 mm wide; with translucent-pink moniliform hairs along the margins, c. 0.5 mm long; pollen cream; stigma 1, pulviniform and positioned between the spent vertical anthers, stigma c. 1.2 mm long, c. 0.8 mm wide and projected forwards c. 0.3 mm when mature. *Capsule* not seen. *Seeds* not seen. (Figure 9)

*Diagnostic features.* *Stylidium nitidum* is distinguished from all other species within the *S. piliferum* complex by its glabrous scape and inflorescence, and its glossy, glabrous hypanthium and calyx lobes.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 22 Oct. 1996, R. Davis 7917 (PERTH); 1 Dec. 2004, D. Marsh DM 32 (PERTH).

*Vernacular name.* Shiny Triggerplant (here designated).

*Distribution and habitat.* Occurs in the southern Jarrah Forest. Grows in grey sand mostly under *Casuarina* and *Baeckea* species amongst *Casuarina* needle litter in low open woodland, common over a 30 m distance along track higher up than creek line.

*Flowering period.* October to November.

*Conservation status.* Listed by Smith (2017) as Priority One under Conservation Codes for Western Australian Flora, under the name *S. sp.* Glabrous inflorescence (R. Davis 7917). Currently only known from these three herbarium collections.

*Etymology.* The epithet *nitidum* is from the Latin *nitidus* (shiny), and refers to this species' glossy, glabrous hypanthium and calyx lobes.

*Affinities.* Refer to the comparative comments under *S. monticola*.

*Notes.* *Stylidium nitidum* was first collected on a botanical survey by R. Davis in October 1996. Specimens of this species came to light when we were annotating the *S. piliferum* complex collections housed at PERTH in 2007.

**Stylidium piliferum** R.Br., *Prodr. Fl. Nov. Holland.*: 569 (1810). *Candollea pilifera* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type*: King George III's Sound, December 1801, R. Brown s.n., Bennett No. 2583 [*lecto*, *fide* J.A. Wege, *Nuytsia* 20: 85 (2010): BM; *isolecto*: BM, E, K 000060745].

*Stylidium piliferum* var. *minor* Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 71 (1908). *Stylidium piliferum* subsp. *minor* (Mildbr.) Carlquist, *Aliso* 7(1): 40 (1969). *Type*: King George's Sound [Western Australia], December 1801, R. Brown s.n., Bennett No. 2583 [*lecto*, *fide* J.A. Wege, *Nuytsia* 20: 85 (2010): BM; *isolecto*: BM, E, K 000060745]. *Paralecto* [residual syntypes]: Kent, Hammersley River, October 1901, L. Diels 4931 (B, n.v., destroyed in WWII).

*Stylidium saxifragoides* Lindl., *Sketch Veg. Swan R.* xxviii (1839). *Type*: not cited [*fide* J.A. Wege, *Nuytsia* 20: 85 (2010): Swan River, Western Australia, s. *dat.*, J. Drummond s.n. (*holo*: CGE; *iso*: K 000060754)].

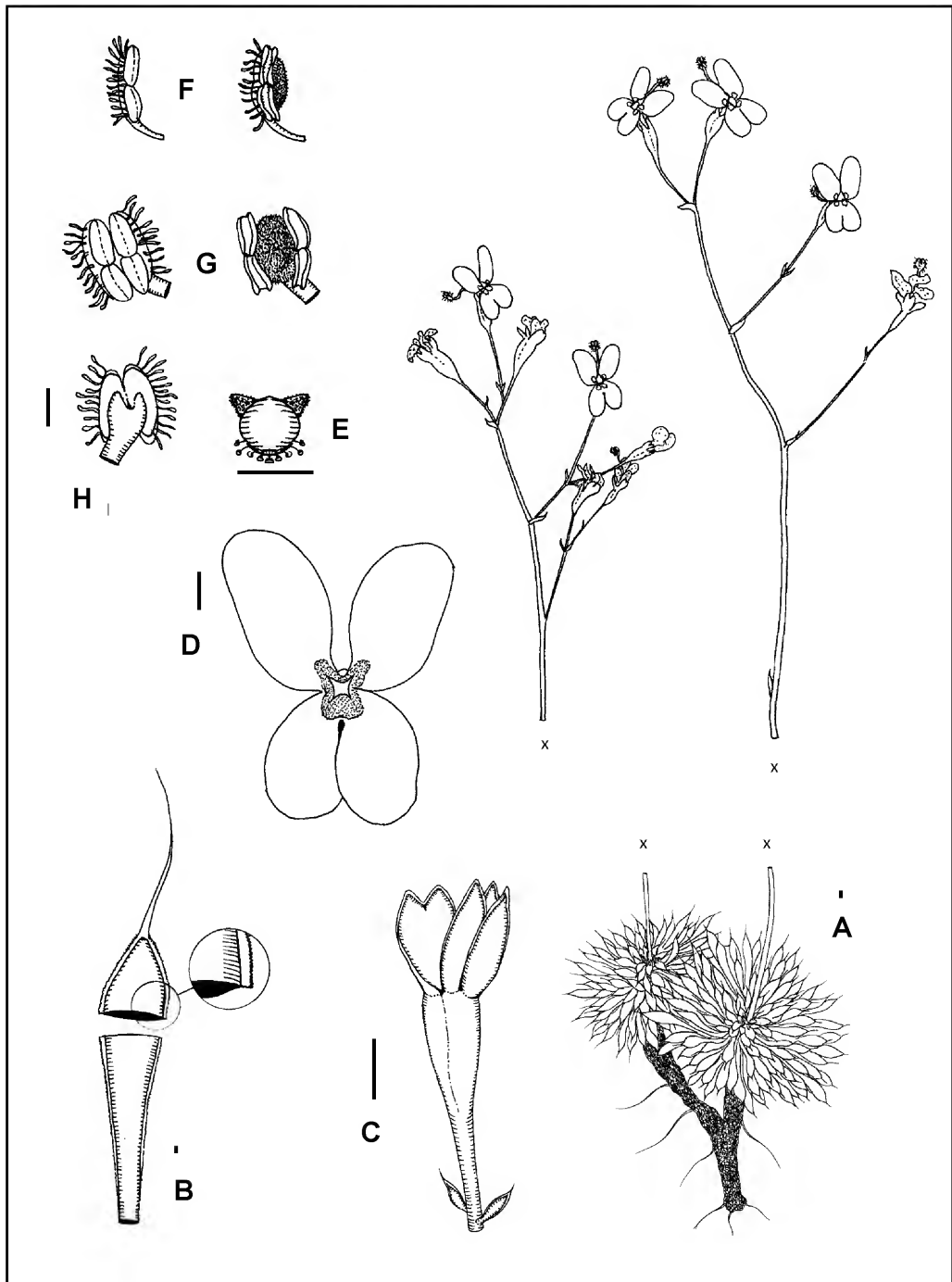


Figure 9. *Stylidium nitidum*. A – habit of flowering plants; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, and glabrous pedicel with bracteoles; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with stigma grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 3736 & G. Graham.

*Perennial herb*, 35–50 cm tall, with basin-like rosettes of regularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants solitary from an unbranched stem, with the base adpressed to the soil; older plants comprising 3 to 8 clustered rosettes arising from the apices of below-ground stems with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green blushed with pale maroon on adaxial surface, pale maroon on abaxial surface, oblanceolate, slightly incurved apically, transversely narrowly cuneate in T.S., 2–2.5 cm long, 0.8–1 mm wide near the base, 1.5–1.6 mm wide near the apex, c. 0.5 mm thick, margins hyaline, serrulate, apical mucro translucent-white, 1–4 mm long. *Scape* glabrous; bracts rarely present but when present similar to the floral bracts. *Inflorescence* paniculate, peduncles 1–6-flowered, the basal ones 1.2–3.5 cm long, the upper ones shorter, pedicels 5–10 mm long, inflorescence throughout densely glandular, glandular trichomes short and long; floral bracts linear to narrowly elliptic, 2.5–6 mm long, margins hyaline, serrulate, basally glandular, translucent-white apical mucro 0.8–2 mm long; bracteoles similarly shaped 1–2 mm long, with a shorter or absent mucro as well as glands occurring closer to the apex. *Hypanthium* ellipsoidal at anthesis, 3–5 mm long, 1.6–1.7 mm wide, densely glandular, with short and long glandular trichomes. *Calyx* moderately densely glandular, with short and long glandular trichomes, 2 lobes connate almost to their apex, 3 lobes free to base, 2–2.5 mm long. *Corolla* white, abaxial surface white with a faint pinkish stripe near base of each corolla lobe; lobes vertically-paired; anterior lobes 5–6.5 mm long, 2–3 mm wide, with a little, yellow, stippled mark near the base; posterior lobes 4–5 mm long, 1.5–2.3 mm wide, bearing a yellow, strap-like mark having an emarginate apex, extending from the throat of the corolla onto the base of each lobe. *Labellum* boss yellow, broadly elliptic, c. 0.8 mm long, c. 0.6 mm wide, smooth; basal appendages 2, yellow, triangular, c. 0.3 mm long, papillose; margins yellow, dentate, papillose. *Throat* appendages absent. *Gynostemium* c. 1.3 mm long, reddish, torus yellow; anthers dark red, positioned c. 45° to the gynostemium, with reddish moniliform hairs along the margins; pollen white; stigma elliptic, pulviniform, c. 1.8 mm long, c. 0.8 mm wide. *Capsule* ellipsoidal, c. 5 mm long, c. 3 mm wide. *Seeds* not seen. (Figure 10)

*Diagnostic features.* *Stylidium piliferum* is distinguished from all other members of the complex by having: oblanceolate leaves, with a translucent-white, serrulate, hyaline margin; a densely glandular, ellipsoidal hypanthium; calyx lobes with 2 calyx lobes connate almost to their apex and 3 free to base; a white corolla with yellow marks near the base of each corolla lobe.

*Selected specimens examined.* WESTERN AUSTRALIA: Marbellup Road, W of Albany on South Coast Highway, 4 Dec. 2009, *W.S. Armbruster* 09-113 (PERTH); Richards Road at NE boundary of Gull Rock National Park, 5 Dec. 2009, *W.S. Armbruster* 09-120 (PERTH); near top of hill above Betty's Beach, 8 Dec. 2009, *W.S. Armbruster* 09-127 (PERTH); SE corner of reserve, Shirley Balla Swamp, 28 Nov. 2013, *L. Barrett* 86 (PERTH); 1 km from the Cape Riche Camping Ground along the track to the Salmon Fishermen's camp, 8 Oct. 2013, *G. Byrne* 4864 (PERTH); site MR1. 6 km W on Mowen Road from Vasse Highway, Nannup, 16 Nov. 2001, *R.J. Cranfield* 17478 (PERTH); Boyup Brook road to Donnybrook 21 km NNW of Boyup Brook, 3 Nov. 2011, *R.J. Cranfield* 25892 & *G. Henderson* (PERTH); Kent Road, c. 3 km N of Qualen Road. Gunapin Block, Wandoo National Park, 10 Nov. 2008, *A. Crawford* 1880 (PERTH); Lake Mealup, Pinjarra, 18 Oct. 2003, *K.E. Creed* 118 (PERTH); Pinjarra Industrial Area, 24 Oct. 2002, *P. Foreman* PJ 243 & *J. Kelly* (PERTH); walk trail along Oldfield estuary, c. 1 km S from Access Road off Munglinup Beach Road, 9 Oct. 2006, *M. Hislop* 3667 (PERTH); Bow River, SW Western Australia, Dec. 1912, *S.W. Jackson s.n.* (PERTH); W of South West Highway, on Storey Road, Waroona, 1 Nov. 1991, *A. Lowrie* 450 (PERTH); road off to right c. 10 km S of Ravensthorpe on Hopetoun Road, 25 Sep. 2006, *D.E. Murfet* 5402 & *A. Lowrie* (AD); Reserve A21064 located c. 15 km directly NE of Arthur River townsite, 2 Nov. 2002, *F. Obbens* 63/02 & *H. Jensen* (PERTH); Wilgie Creek Reserve, 40339, W side of Yunderup Road North, N side

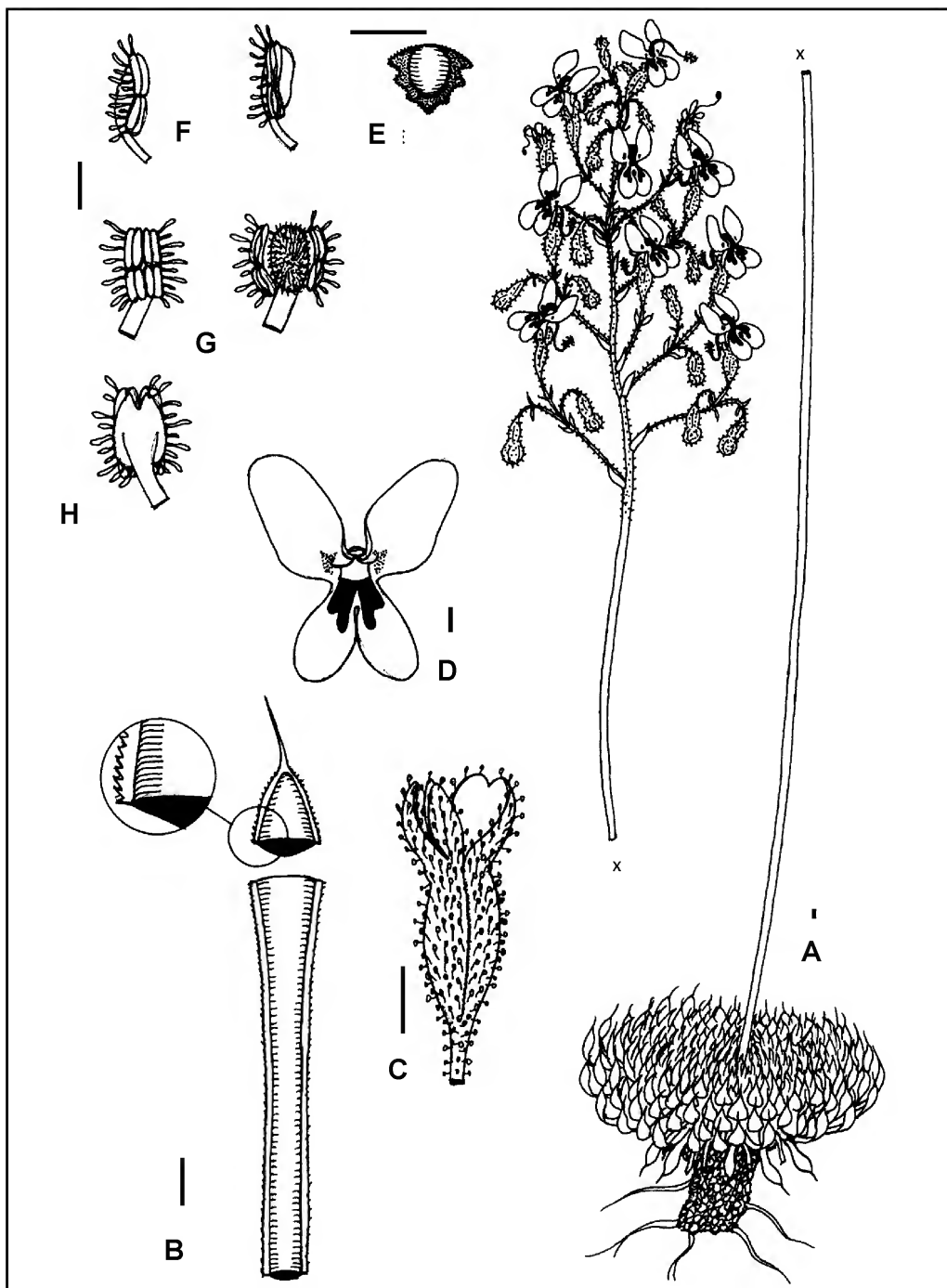


Figure 10. *Stylidium piliferum*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with the stigma grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 450.

of creek, North Yunderup, Pinjarra, 16 Sep. 2002, *P.G. Payne* 57 (PERTH); 8 km from Two Rocks, near the intersection of Smokebush and Tringa Roads, Two Rocks, 21 Sep. 2002, *K.C. Richardson* 104 (PERTH); 200 m N of Gracetown Road, near E boundary of National Park, NW of Margaret River, 20 Oct. 1999, *J. Scott* 122 (PERTH); Cape Le Grand, Transect E1, Cape Le Grand National Park, 1 Nov. 2001, *C. Tauss* 1-21 (PERTH); N of Gngangara Road, W side of Lot 46 Maralla Road, locality of Ellenbrook, 28 Oct. 1999, *M.E. Trudgen* 20574 & *M. Wood* (PERTH); quadrat 3, Reserve 424, West Talbot Road, York, 26 Oct. 2002, *C. & A. Warburton* 9 (PERTH); 3.9 km S. on Shelly Beach Road from Coombes Road, West Cape Howe National Park, W of Albany, 4 Dec. 2003, *J.A. Wege* 1160 (PERTH); track E of railway line, S of South Coast Highway, Marbellup Nature Reserve, W of Albany, 2 Nov. 2010, *J.A. Wege* 1803 (PERTH).

*Vernacular name.* Common Butterfly Triggerplant (Erickson 1958).

*Distribution and habitat.* Occurs on the Swan Coastal Plain, in the southern Jarrah Forest and east to the Esperance Plains. Grows: in grey sand on an east down-sloping hill in low shrubland; on low lying plain with grey sand in *Banksia* woodland with *Anigozanthos manglesii*, *Banksia attenuata*, *Boronia crenulata*, *B. ramosa*, *Burchardia congesta*, *Caesia* sp., *Chamaescilla corymbosa*, *Stylidium* sp., *Thysanotus patersonii*; in wetland with bare dry white-grey sand to clayey sand surrounded by forest to shrubland associated with *Eucalyptus marginata* and *Persoonia longifolia*; in sandy soils in dense coastal heath at base of small boulders; on hill slope above winter-wet area in white sand in *Allocasuarina* - *Eucalyptus* woodland; on plain with gentle slope in grey sand in open *Eucalyptus marginata*, *Eucalyptus wandoo* woodland with low open shrubs and *Xanthorrhoea preissii*; in dry white sand in 1–1.5 m heath over dense sedges with *Adenanthos cuneatus*, *Banksia repens* and *Lepidosperma carphoides*; in ironstone pebbles with sand in heathland; in yellow-grey sand over granite with light litter in low Peppermint woodland with *Banksia attenuata*, *Nyctisia floribunda*, *Melaleuca thymoides*, *Dasyopogon bromeliifolius*.

*Flowering period.* September to December.

*Conservation status.* Reasonably widespread and well-represented within the conservation estate.

*Etymology.* The epithet is from the Latin *pilifer* (bearing hairs) and refers to the apex of the leaf which ends in a hair-like point. The term mucro has been adopted by us to describe the apical leaf appendage.

*Notes.* Although *Stylidium piliferum* is reasonably consistent in its morphological characters it does vary considerably in overall size of plants.

***Stylidium ponticulus*** Lowrie & Kenneally, *sp. nov.*

*Type:* Kalbarri National Park, near place called Z Bend by Murchison River, Western Australia, 9 October 1982, *A. Strid* 20802 (*holo:* PERTH 02969106; *iso:* MEL).

*Stylidium* sp. Kalbarri (A. Carr 145) *p.p.*, Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 15–18 cm tall, with basin-like rosettes of regularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising

1 or more clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* silvery grey-green and shiny on both surfaces, oblanceolate, incurved, narrowly obtriangular with a prominent abaxial longitudinal mid-vein in T.S., 1.2–1.7 cm long, 0.6–0.8 mm wide near the base, gradually dilating to 1.3–1.8 mm wide near the apex, *c.* 0.4 mm thick, margin hyaline, serrulate, 0.1–0.15 mm wide, apical mucro translucent-white, 1–1.8 mm long. *Scape* glabrous; bracts absent. *Inflorescence* racemose, densely covered with golden glandular trichomes 0.2–0.4 mm long, tipped with blackish maroon glands, pedicels (and peduncles that sometimes occur) glandular; floral bracts ovate, 2–2.5 mm long, 0.6–0.8 mm wide, apical mucro translucent-white, 1.2–1.5 mm long, margins hyaline, translucent-white, serrulate; bracteoles similar, 1.2–1.5 mm long, 0.4–0.6 mm wide. *Hypanthium* dark green,  $\pm$  narrowly ellipsoidal at anthesis, 3.5–4 mm long, 1.3–1.8 mm wide, densely covered with golden glandular trichomes 0.2–0.4 mm long, tipped with blackish maroon glands. *Calyx* with 2 lobes connate almost to their apex, 3 lobes free to base, 2–2.5 mm long, margins hyaline, a little irregular but mostly entire, moderately covered with golden glandular trichomes 0.2–0.4 mm long, tipped with blackish maroon glands. *Corolla* white, or pale yellow fading to white, or pale pink with darker pink margins, abaxial surface white, moderately glandular with scattered, translucent trichomes tipped with blackish maroon glands; lobes vertically-paired; posterior lobes 3–4 mm long, 2.8–3.7 mm wide, fused at their base to form a little greenish yellow-coloured bridge 1–1.5 mm long, 1–1.5 mm wide which is connected to the anterior lobes, posterior lobes with large red marks positioned on the white section just before the greenish yellow base; anterior lobes 6–7 mm long, 3–3.8 mm wide, white with smaller red marks near the base. *Labellum* boss pale green, broadly elliptic, *c.* 0.9 mm long, *c.* 0.8 mm wide, smooth; basal appendages 2, pale green, lateral, subulate, *c.* 0.5 mm long, *c.* 0.3 mm wide at the base, papillose; margins reddish, papillose. *Throat* greenish yellow, appendages absent. *Gynostemium* *c.* 11.5 mm long, reddish, torus reddish and/or yellow; anthers dark maroon, positioned *c.* 45° to the gynostemium; with translucent-red moniliform hairs along the margins; pollen yellow; stigmas 1, gibbose, between the spent vertical anthers, *c.* 1.5 mm long, *c.* 0.8 wide. *Capsule* not seen. *Seeds* not seen. (Figure 11)

*Diagnostic features.* *Stylidium ponticulus* is distinguished from all other members of the *S. piliferum* complex by its silvery grey-green basal rosette of neatly arranged, shiny leaves; corolla white, or pale-yellow fading to white, or pale pink with darker pink margins; small posterior corolla lobes that are narrowly fused at their base to form a distinctive little bridge between the anterior and posterior lobes.

*Selected specimens examined.* WESTERNAUSTRALIA: [specimens with corolla white or pale yellow fading to white] 5 km along Robinson Road from Bunney Road, SW of Mingenew, 17 Oct. 1992, A. Carr 145 (MGW., PERTH); 20 km S [of] Kalbarri, 11 Oct. 1984, D. & B. Bellairs 2080 (PERTH); Vermin fence – S of Kalbarri, 8 Oct. 1988, D.R. & B. Bellairs 2077 (PERTH); N side of Ajana-Kalbarri road, 12.3 km from townsite, 30 Oct. 1999, D. & B. Bellairs 6118 (KALB., PERTH); Kalbarri National Park, near Ajana-Kalbarri Road, 9 Sep. 1993, K. Bremer & M. Gustafsson 53 (PERTH, UPS); between turnoff to Pot Gorge and Pot Gorge, 26 Sep. 1974, G. Perry 305 (PERTH); [specimens with corolla pink] 20 km SE of Dongara, 14 km WSW of Mt Adams, 14 Nov. 1979, S.D. Hopper 1517 (PERTH); SW sector of Boonanarring Nature Reserve, Gingin, 22 Nov. 2001 F. & J. Hort 1652 (PERTH); in beige sand in Yardanogo Nature Reserve W of Mt Adams, SE of Dongara, 22 Oct. 2007, A. Lowrie 3613 (MEL, PERTH); in beige sand N of Origin Gas Plant, Yardanogo Nature Reserve W of Mt Adams, SE of Dongara, 22 Oct. 2007, A. Lowrie 3618 A (MEL, PERTH).

*Vernacular name.* Bridge-petalled Triggerplant (here designated).

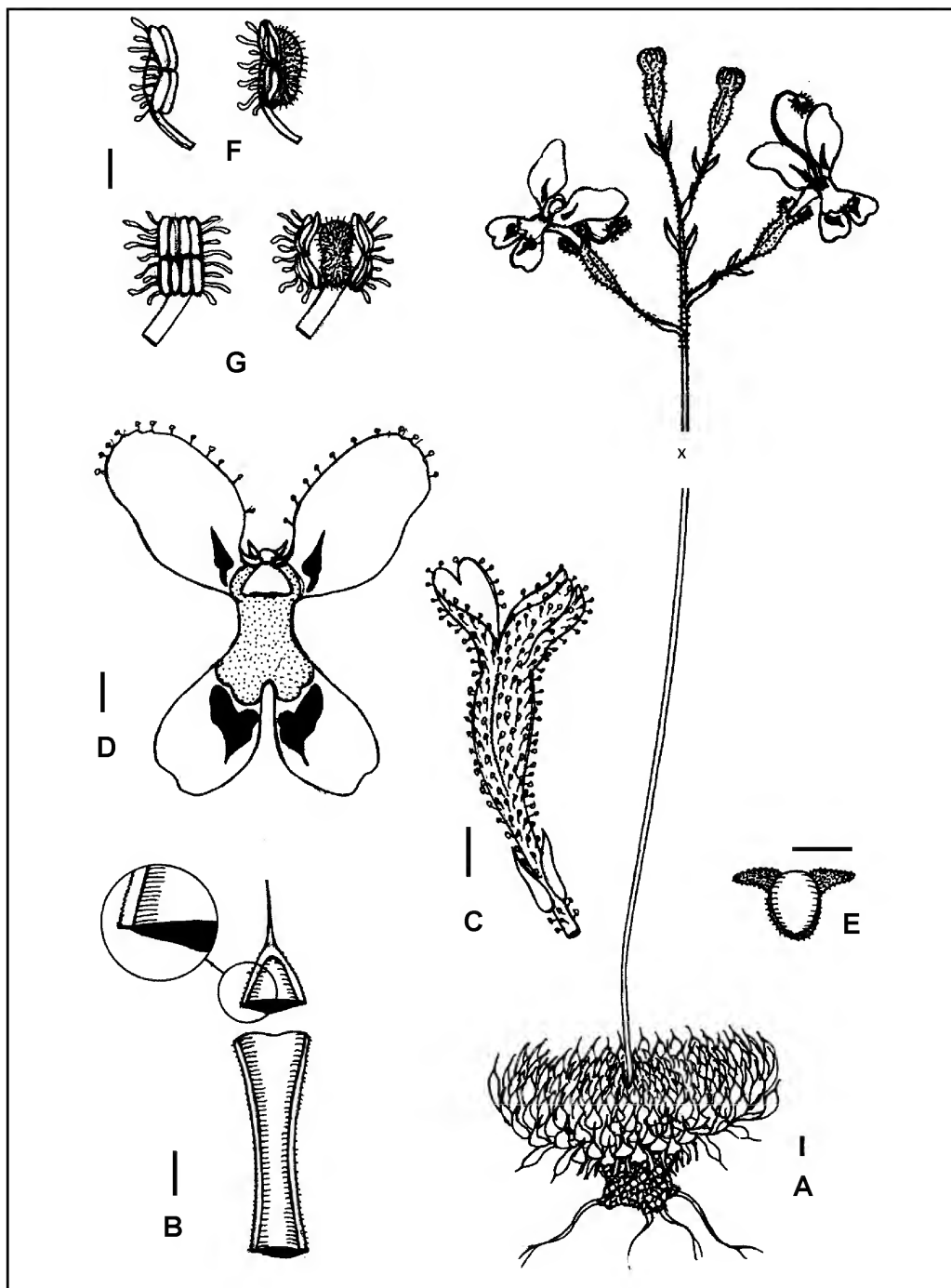


Figure 11. *Styliidium ponticulul*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, and glabrous bracteoles; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with the stigma grown out (right). Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 637.

*Distribution and habitat.* Occurs on the north Swan Coastal Plain from Dongara to Kalbarri National Park. The white, or pale-yellow fading to white-flowered forms grow in light brown sand, yellow sand, and white sand or beige sand on heathland. The pink-flowered form occurs west of Mt Adams, south-east of Dongara growing in beige or deep yellow sands in heathland with *Banksia hookeriana*, *B. menziesii*, *B. elegans* and *B. attenuata*.

*Flowering period.* September to November.

*Conservation status.* Reasonably widespread and well-represented within the conservation estate.

*Etymology.* The epithet is Latin and means ‘little bridge’, and is used as a noun in apposition. It refers to the distinctive bridge between the anterior and posterior corolla lobes.

*Affinities.* *Stylidium ponticulus* is morphologically similar to *S. amphora* and *S. salmoneum* Lowrie & Kenneally, which both have posterior corolla lobes that are more or less fused at their base to form a bridge between the anterior and posterior lobes. In *S. ponticulus*, however, the posterior corolla lobes’ basal constriction is rather narrow and is prominently displayed as a little bridge when it is in full flower, whereas the flowers of both *S. amphora* and *S. salmoneum* have the bases of the anterior and posterior corolla lobes almost touching each other and rarely display the bridge between their corolla lobes.

The corolla of *S. ponticulus* is 9–11 mm long, either white or pale yellow fading to white, or pale pink with darker pink margins, whereas *S. amphora* has a yellow corolla 13–14 mm long and *S. salmoneum* has a salmon-pink to orange corolla 11–12 mm long. *Stylidium ponticulus* is further distinguished from these species by its basal rosette of regularly arranged, shiny, silvery grey-green leaves; the leaves of *S. amphora* and *S. salmoneum* are green, not shiny, and unevenly or irregularly arranged within the rosette.

*Notes.* Some herbarium specimens at PERTH (i.e. PERTH08172439; 07487002; 05728886; 05728894; 05728983; 05480787; 05728878) were annotated by one of us (AL) and attributed to *S. ponticulus* in 2007; these are all referable to *S. salmoneum*.

***Stylidium pubigerum*** Sond., in Lehm., *Pl. Preiss.* 1(3): 383 (1845). *Candollea pubigera* (Sond.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type:* In solo limoso arenoso inter frutices prope Woodbridge, Perth [Western Australia], 14 October 1839, *L. Preiss* 2278 (*lecto, fide* J.A. Wege, *Nuytsia* 25: 199 (2015): MEL293413; *isolecto:* BR0000005423217, FI, G00358839, G00358840, G00358841, GOET 011208, L 0012063, LD 1745431, M 0175788, MEL 293411, MEL 293412, MO-797522, P00712418, TCD [as *L. Preiss* 651 *p.p.*], W). *Paralectotypes* [*residual syntypes*]: Swan River [Western Australia, 1841], *J. Drummond* [1:] 543 (BM 001041318, E 00279184, G 00358835, G 00358836, K 000060759, K 000355288, K 000355293, MEL 2295042, OXF, P 00712423, P 00313120, W).

*Perennial herb*, 6–12 cm tall, with basin-like rosettes of regularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons’ growth; young plants solitary from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 12 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season’s rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, incurved, transversely obtriangular with a prominent abaxial longitudinal mid-vein in T.S. in its upper part, 1.8–2 cm long, 0.7–1.2 mm wide near the base, gradually dilating to 1.3–2.5 mm wide near the apex, *c.* 0.7 mm thick, hyaline margin translucent-white, 0.1–

0.15 mm wide, serrulate in its lower half and either serrulate or entire in its upper half, apical mucro translucent-white, hair-like, 2.5–5 mm long. *Scape* reddish, glabrous; bracts absent. *Inflorescence* racemose, sometimes in groups of 2 or 3 flowers on a peduncle, inflorescence moderately covered throughout with non-glandular trichomes; floral bracts green, ovate, 2.5–3 mm long, 0.8–1 mm wide, hyaline margins serrulate and hair-like mucro translucent white, 1–1.2 mm long; bracteoles similar, 1–1.5 mm long, 0.3–0.5 mm wide, hair-like mucro translucent white, 0.5–0.7 mm long. *Hypanthium* reddish, narrowly oblong at anthesis, 7–12 mm long, 1.2–1.5 mm wide, densely covered with golden green, non-glandular trichomes *c.* 1 mm long. *Calyx* distinctly 2-lipped, 2 lobes connate, lobes free for 0.5–0.6 mm from their apex and 3 lobes connate, lobes free for 0.5–1 mm from their apex, margin hyaline±absent, entire, densely fringed and covered with similar golden green non-glandular trichomes to those on the hypanthium. *Corolla* pale yellow, abaxial surface yellow with faint reddish marks along mid-vein area, glandular; lobes vertically-paired; anterior lobes 4.5–6.5 mm long, 2.5–3 mm wide, mostly with reddish marks near the base; posterior lobes 3–4 mm long, 2.2–2.5 mm wide, with mostly reddish markings near the base. *Labellum* boss yellow, ± broadly reniform, *c.* 1 mm wide, smooth; margins with a very narrow, reddish, papillose beard and bearing a few glandular trichomes *c.* 0.4 mm long. *Throat* greenish yellow, appendages absent. *Gynostemium* *c.* 13.5 mm long, reddish, torus greenish yellow; anthers yellow, reddish along margins of openings, positioned *c.* 60° to the gynostemium, with very short, translucent-red moniliform hairs along the margins; pollen yellow, vitreous; stigmas 2, ellipsoidal, one projected above and the other below between the spent vertical anthers, *c.* 1 mm long. *Capsule* not seen. *Seeds* not seen. (Figure 12)

*Diagnostic features.* *Stylidium pubigerum* is distinct from all other members of the *S. piliferum* group by having two and three of its calyx lobes fused together to form two lips; narrowly oblong reddish hypanthium that is densely covered with non-glandular trichomes.

*Selected specimens examined.* WESTERN AUSTRALIA: Midland Junction, Oct. 1902, *C. Andrews s.n.* (PERTH); between Bolgart and Wyening, 3 Oct. 1967, *S. Carlquist* 3598 (PERTH); John Forrest National Park S of Railway, 6 Oct. 1998, *R. Davis* 6802 (PERTH); E of the Lakes turnoff on road to York, Wambyn Nature Reserve, 9 Oct. 1998, *R. Davis* 7181 (PERTH); Bolgart, 6 Oct. 1952, *R. Erickson s.n.* (PERTH); Chidlow–Wooroloo, Oct. 1951, *J. Gentilli s.n.* (PERTH); Owen Road, Darlington, Oct. 1965, *S. James* 65.10/27 (PERTH); Glen Road, Darlington, Oct. 1973, *S. James* 71.10/20 (PERTH); 6 miles [9.66 km] S of Toodyay on Toodyay-Perth Road, Sep. 1974, *S. James* 74. 9/19 (PERTH); on Albany Highway 20.7 km N of Williams, 8 Oct. 1991, *A. Lowrie* 373 (PERTH); The Lakes just E of turnoff to York, 11 Oct. 1992, *A. Lowrie* 691 (PERTH); Bowelling-Duranillin Road, 2 km from junction of Roelands-Lake King Highway, SW of Darkan, 31 Oct. 1994, *A. Lowrie* 1079 (PERTH); 4 km W of Bakers Hill, 14 Oct. 1989, *B. Nordenstam & A. Anderberg* 636 (PERTH); Cannington, 27 Sep. 1982, *G.J. Weber s.n.* (PERTH); 400 m along track 5.2 km E of Albany Highway on Extracts Road, Wandering Shire, 22 Oct. 2002, *J.A. Wege* 706 (PERTH); *c.* 9.9 km S of Brookton Highway on Watershed Road, 16 Oct. 2008, *J.A. Wege* 1551 & *A.D. Crawford* (PERTH); junction of Forest Street and Bolgart West Road, Bolgart, 1 Oct. 1996, *J.A. Wege* 236 & *C. Wilkins* (PERTH).

*Vernacular name.* Yellow Butterfly Triggerplant (Erickson 1958).

*Distribution and habitat.* Occurs throughout the Jarrah Forrest from John Forrest National Park to Wandering. Grows: on upper hill-slopes in brown loam over laterite in open wandoo woodland in yellow-brown clayey sand over laterite in open marri, jarrah and wandoo woodland; on flat slope with dry yellow brown gravel, laterite and granite sheet in marri and wandoo woodlands with *Allocasuarina huegeliana*, *Xanthorrhoea preissii*, *Grevillea pilulifera* and *Hibbertia hypericoides*; granite outcrop in yellow-grey clayey sand in low shrubland of *Verticordia*, *Hakea*, *Hibbertia*, sedges and *Xanthorrhoea*;

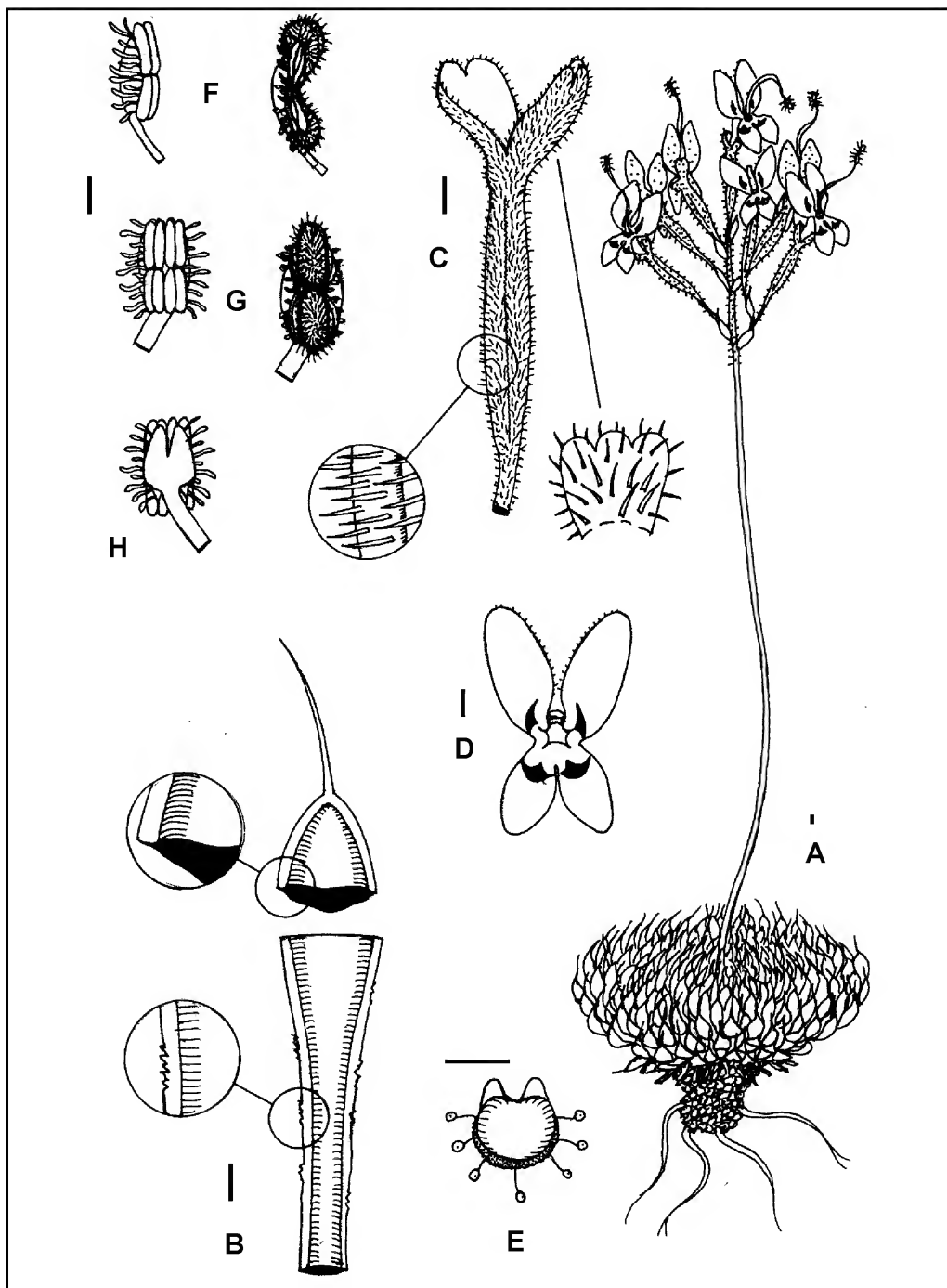


Figure 12. *Stylidium pubigerum*. A – habit of flowering plant; B – leaf, and enlarged sections (insets); C – hypanthium and calyx lobes, with details of indumentum (inset) and trilobed apex of connate calyx lobes; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with the stigmas grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 691.

upland, middle of rise in heavy brown clay over granite with sedges in low open woodland; red-brown clayey sand in open *Eucalyptus* woodland.

*Flowering period.* September to December.

*Conservation status.* Not threatened.

*Chromosome number.*  $n=14$  *fide* S. James 71.10/20 Oct. 1971 (James 1979).

*Etymology.* The epithet is from the Latin *pubi*- (softly hairy) and *-ger* (bearing), a reference to its indumentum of non-glandular trichomes.

*Affinities.* *Stylidium pubigerum* is morphologically distinct from all other species within the *S. piliferum* complex by its narrowly oblong hypanthium with two and three of its calyx lobes fused together to form two lips, all covered with non-glandular trichomes.

*Notes.* The two stigmas, one projected above and the other below the anthers, are not always fully-developed together. The lower stigma is present in rudimentary form only when the upper stigma is fully mature. Often this lower stigma does not develop to maturity if the upper stigma has been pollinated.

A population of *S. pubigerum* comprising plants with pale yellow flowers without reddish marks near the corolla lobe bases, has been observed in the Red Hill area of the Darling Range. Other than flower colour this population is similar to the rest in all of its other morphological characters.

***Stylidium salmoneum* Lowrie & Kenneally, *sp. nov.***

*Type:* Luelf Road off Gunapin Ridge Road, Gunapin State Forest, under power lines *c.* 100 m south from farm fence, south-east of Reference Tree AZ 92/1, Western Australia, 17 November 1999, A. Lowrie 2433 & F. & J. Hort (*holo:* PERTH 08702462; *iso:* MEL).

*Perennial herb*, 14–32 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 1 to 6 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, incurved, transversely lenticulate in T.S., 1.4–2 cm long, 1.3–1.5 mm wide near the base, narrowing just above the base to 0.8–1 mm wide, dilating to 1.5–2 mm wide near the apex, *c.* 0.5 mm thick, margins hyaline, serrulate, 0.1–0.2 mm wide, apical mucro translucent-white, 2–3.5 mm long. *Scape* glabrous; bracts absent. *Inflorescence* racemose, sometimes paniculate in the lower parts, inflorescence glandular, trichomes translucent-white, 0.2–0.4 mm long, tipped with blackish maroon glands; floral bracts ovate, 2–2.5 mm long, 1–1.5 mm wide, apical mucro translucent-white, 0.5–1 mm long, margins hyaline, serrulate; bracteoles similar, 1.5–2 mm long, 0.6–0.7 mm wide. *Hypanthium* dark green, ellipsoidal to narrowly obovoid at anthesis, 3.5–4 mm long, 1.5–1.8 mm wide, densely glandular, trichomes translucent-white 0.2–0.4 mm long, tipped with blackish maroon glands. *Calyx* sparsely glandular, 2 lobes connate almost to their apex, 3 lobes free to base, 2–2.5 mm long, margin hyaline, serrulate. *Corolla* salmon-pink (from pink [R.H.S. Red-Purple 62C] to orange [R.H.S. Orange 27A to 28B]), abaxial surface whitish with pinkish margins and a reddish stripe along mid-vein near base, moderately glandular with scattered translucent-white

trichomes 0.2–0.4 mm long, tipped with blackish maroon glands; lobes vertically paired; anterior lobes 6–6.5 mm long, 3.7–4 mm wide, unmarked; posterior lobes 5–5.5 mm long, 3–3.2 mm wide, with a large, reddish mark near the base. *Labellum* boss greenish yellow, obovate, c. 0.8 mm long, c. 0.7 mm wide, smooth; basal appendages 2, greenish yellow to reddish at base, lateral, subulate, c. 0.7 mm long, c. 0.2 mm wide at the base, c. 0.1 mm wide near the apex, papillose; margins and c. 0.2 mm long apex, papillose. *Throat* greenish yellow, appendages absent. *Gynostemium* c. 14 mm long, reddish; torus pale yellowish green and shiny; anthers blackish maroon, positioned in line with the gynostemium, with translucent-red moniliform hairs along the margins; pollen pale yellow; stigmas 2, mammiform, c. 1.5 mm long, c. 1 mm wide. *Capsule* obovoid, 5–6.5 mm long, 2.5–3 mm wide. *Seeds* ± ovoid in outline with ± angled longitudinal sides, 0.5–0.6 mm long, 0.3–0.35 mm wide, brown, testa papillose. (Figure 13)

*Diagnostic features.* *Stylidium salmoneum* is distinguished from all other members in the *S. piliferum* complex by its salmon-pink corolla lobes, which bear large, reddish marks near the base of the posterior pair only.

*Selected specimens examined.* WESTERN AUSTRALIA: Wattening, on the NE corner of Munyerring Block, Julimar CON, off the southern boundary of Training area, c. 3 km N of Bindoon-Dewars Pool Road. On E side of the granite outcrop, 28 Dec. 2005, *F. Hort* 2897 (PERTH); Bolgart, 7 Nov. 1948, *R. Erickson s.n.* (PERTH); Deefor Road, Flynn State Forest, York: take Deefor Road for 1.75 km E of Kent Road then take the minor track N for 550 m to the SE edge of the shrubland, 20 Nov. 1999, *F. Hort, J. Hort & M. Hislop* 803 (PERTH); Qualen Road, Gunapin State Forest, York: 11.1 km E of Catchment Road, 20 Nov. 1999, *F. Hort, J. Hort & M. Hislop* 804 (PERTH).

*Vernacular name.* Salmon-Pink Triggerplant (here designated).

*Distribution and habitat.* Occurs in the Jarrah Forrest, extending into the Avon Wheatbelt. Grows in yellow-grey, yellow-brown clayey sand over decomposed sheet granite in open areas with granitic heathland vegetation surrounded by wandoo, jarrah and marri woodland.

*Flowering period.* November to December.

*Conservation status.* A restricted but common species at the majority of its known locations and currently not threatened.

*Etymology.* The epithet is Latin, meaning ‘salmon-pink’ and refers to the colour of the corolla. The corolla can vary from one population to the next, being any of the hues in the Royal Horticultural Society (1986) colour charts between R.H.S. Red-Purple 62C to R.H.S. Orange 27A or 28B.

*Affinities.* *Stylidium salmoneum* is distinguished from all other species within the *S. piliferum* complex that have a glandular, ellipsoidal to narrowly obovoid hypanthium (at anthesis), and glandular calyx lobes, by its large, reddish marks near the base of the posterior lobes. The anterior lobes of this species lack the reddish marks seen on *S. amphora*, *S. bicolor*, *S. hispidum* and *S. ponticulus*.

*Stylidium salmoneum* is morphologically similar to *S. amphora* and *S. ponticulus*, and the differences between these three species are given in *Affinities* below the description of *S. ponticulus*.

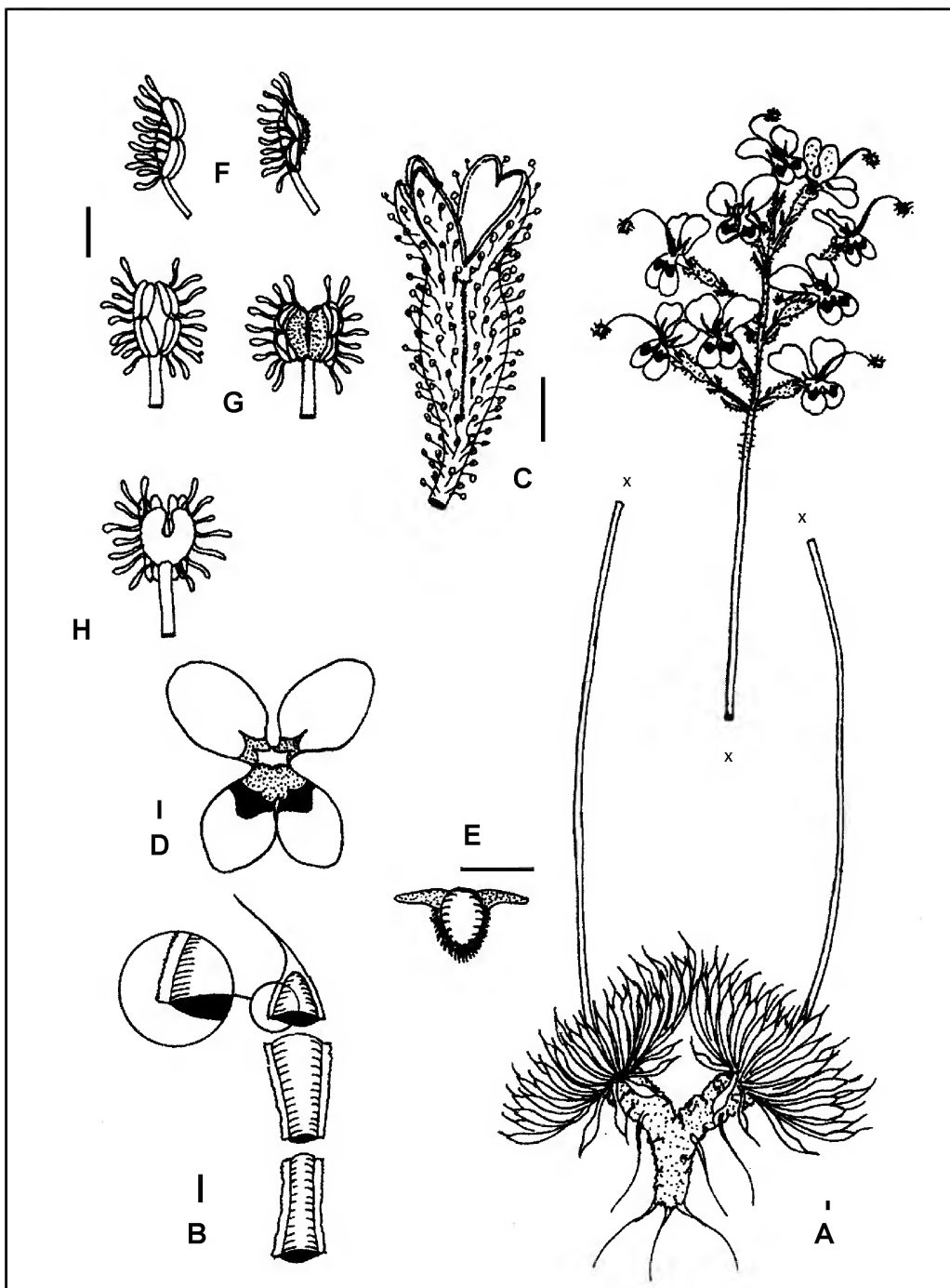


Figure 13. *Styliidium salmonium*. A – habit of flowering plants; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigma grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with the stigma grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 2433 & F. & J. Hort.

*Notes.* Regardless of the corolla colour, the gynostemium of *S. salmoneum* is always reddish, with the torosus (the bent, mobile portion of the gynostemium) positioned just above the throat of the corolla, pale yellowish green, and shiny. When the gynostemium is in the set position and held against the boss of the labellum, the torosus shines and flickers in the sunlight, acting like a nectary gland with promise of a large nectar reward.

***Stylidium strigosum* Lowrie & Kenneally, *sp. nov.***

*Type:* Warradarge, Western Australia [precise locality withheld for conservation reasons], 18 October 1991, A. Lowrie 415 (*holo:* PERTH 08702640; *iso:* MEL).

*Stylidium* sp. Banovich Road (F. & J. Hort 1884), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 9–20 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 6 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, mostly flat, only slightly incurved near apex, transversely narrowly triangular in T.S., 2–5 cm long, 1.2–1.4 mm wide near the base, gradually dilating to 3.5–4 mm wide near the apex, c. 0.5 mm thick, margins hyaline ± entire, irregularly serrate in places, apical mucro translucent-white, stiff, 1–1.2 mm long. *Scape* green, very sparsely covered with strigose, non-glandular trichomes; bracts often present, ovate, 3.5–4 mm long, 1.2–1.4 mm wide, apical mucro 0.5–0.6 mm long, margins hyaline, ± entire. *Inflorescence* racemose, compact, moderately covered throughout with strigose as well as straight, non-glandular trichomes 0.2–0.3 mm long; floral bracts green, similar in shape and size to the scape bracts; bracteoles similar to but much smaller than the floral bracts. *Hypanthium* green, narrowly oblong at anthesis, 8–8.5 mm long, 1–1.5 mm wide, covered with strigose as well as straight, non-glandular trichomes 0.2–0.3 mm long, sometimes also with a few, scattered glandular trichomes. *Calyx* with 2 lobes connate to within c. 0.7 mm of their apex, 2.5–2.8 mm long, 3 lobes free to their base, 2.5–2.7 mm long, margins entire, adaxial surface covered with glandular and non-glandular trichomes similar to those on the hypanthium. *Corolla* salmon-pink to yellow, including all shades and mixtures of these colours in between, abaxial surface yellowish white, glandular; lobes vertically paired; anterior lobes 5.5–6 mm long, 3–3.5 mm wide, with lemon yellow marks near the base, apical margins bearing glands; posterior lobes 4–4.5 mm long, 2.2–2.7 mm wide, with lemon yellow marks near the base. *Labellum* boss pale yellow, ± ovate, c. 0.8 mm long, c. 0.6 mm wide, smooth; basal appendages pale yellow, lateral, subulate, c. 0.5 mm long, c. 0.2 wide at the base; margins with tiny, papillose, pale yellow beard c. 0.2 mm wide. *Throat* lemon yellow, appendages absent. *Gynostemium* c. 11 mm long, pale green, torosus lemon yellow; anthers yellow, positioned c. 45° to the gynostemium; with translucent-pink, clavate, moniliform hairs c. 0.5 mm long along the margins; pollen yellow; stigmas 2, mammiform, one projected above, the other projected below and positioned between the spent vertical anthers, c. 2.8 mm long, c. 0.4 mm wide, projected forwards c. 0.3 mm long when mature. *Capsule* not seen. *Seeds* not seen. (Figure 14)

*Diagnostic features.* *Stylidium strigosum* is distinguished from all other members in the *S. piliferum* complex by its: large, flat, leafy rosettes of irregularly arranged, oblanceolate leaves that are only slightly incurved near the apex; narrowly oblong hypanthium covered with strigose and straight, non-glandular trichomes, sometimes also with a few, scattered glands; flowers being salmon-pink to yellow and all shades and mixtures of these colours in between.

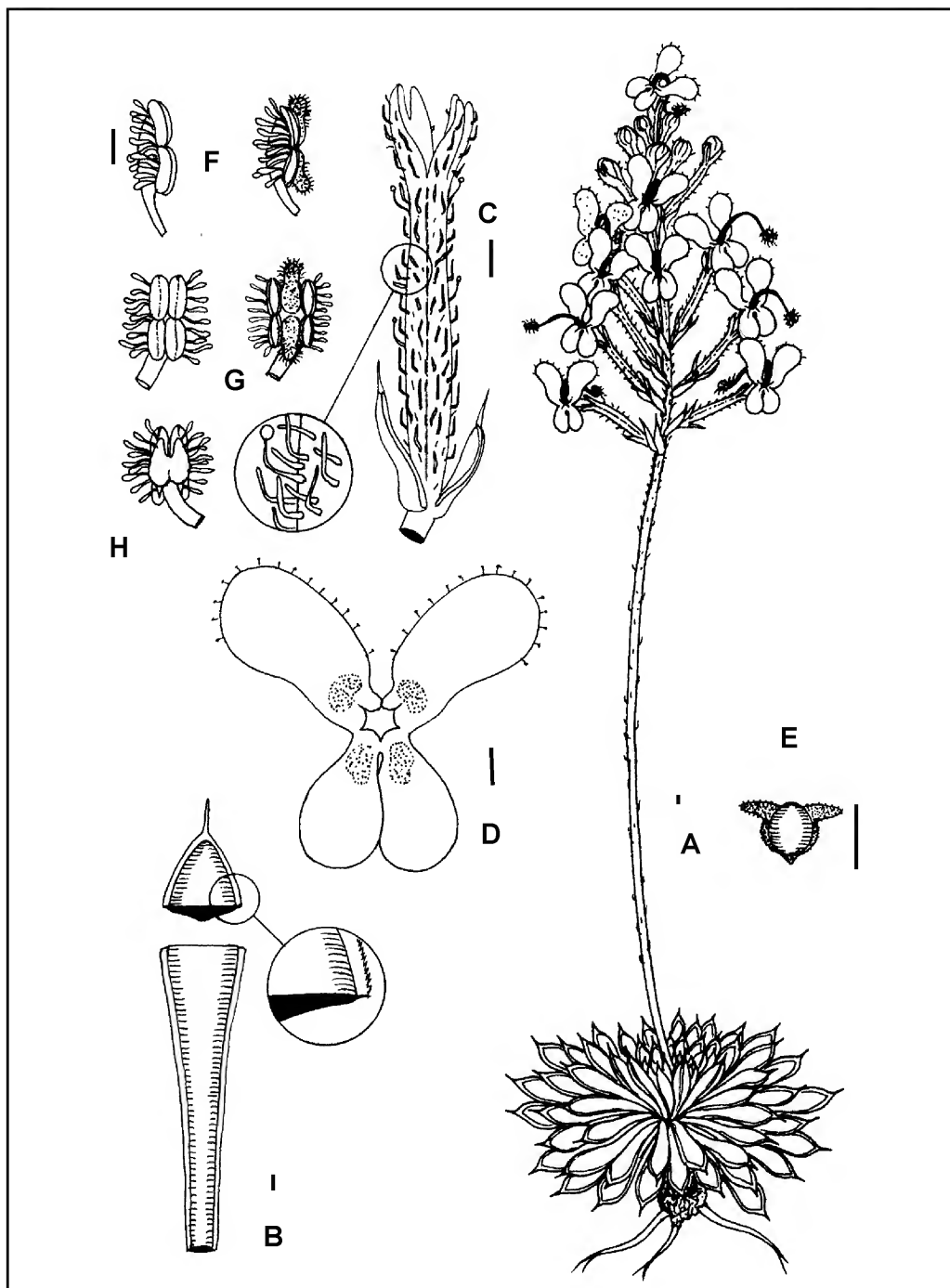


Figure 14. *Stylidium strigosum*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, with detail of indumentum (inset) and glabrous, mucronate bracteoles; D – corolla; E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers (left), and with stigmas grown out (right); H – abaxial view of gynostemium tip at anther stage. Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 415.

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 9 Oct. 2014, A. Lowrie 4379 (PERTH); 11 Oct. 2006, J.A. Wege 1357 (PERTH); 21 Oct. 2009, J.A. Wege 1699 & W.S. Armbruster (PERTH); 30 Sep. 2004, J.A. Wege 1217 & K.A. Shepherd (PERTH).

*Vernacular name.* Strigose Triggerplant (here designated).

*Distribution and habitat.* Occurs in the northern Swan Coastal Plain, growing in white-grey clayey sand over laterite in closed heathland.

*Flowering period.* September to October.

*Conservation status.* Listed by Smith (2017) as Priority One under Conservation Codes for Western Australian Flora, under the name *S. sp.* Banovich Road (F. & J. Hort 1884).

*Etymology.* The epithet is from the Latin *strigosus* (covered with straight, rigid, close-pressed, rather short, bristle-like hairs), a reference to this species' indumentum, especially on the hypanthium.

*Affinities.* *Stylidium strigosum* is morphologically similar to *S. bindoon*, *S. ferricola* and *S. vinosum* as all four species have narrowly oblong hypanthia at anthesis and two connate and three free calyx lobes. Both *S. bindoon* and *S. ferricola* have more or less glabrous calyx lobes whereas *S. vinosum* and *S. strigosum* have both glandular hypanthia and calyx lobes. *Stylidium strigosum* differs from *S. ferricola* by having an indumentum of strigose as well as straight, non-glandular trichomes, whereas that of *S. ferricola* is moderately to sparingly glandular.

*Notes.* First discovered by one of us (AL) in October 1991 adjacent to cleared farmland with some populations extending into an adjoining nature reserve.

***Stylidium vinosum*** Lowrie & Kenneally, *sp. nov.*

*Type:* Julimar Forest, Western Australia [precise locality withheld for conservation reasons], 3 November 1993, K.F. Kenneally 11400 (*holo:* PERTH 03282112).

*Stylidium sp.* Dewars Pool (K.F. Kenneally 11400), Western Australian Herbarium, in *FloraBase*, <https://florabase.dpaw.wa.gov.au/> [accessed 17 June 2015].

*Perennial herb*, 18–23 cm tall, with basin-like rosettes of irregularly arranged leaves, arising from the apices of rhizome-like stems produced during the previous seasons' growth; young plants comprising a single rosette from an unbranched stem, with the base adpressed to the soil; older plants comprising 2 to 6 clustered rosettes arising from the apices of below-ground stems, with their bases adpressed to the soil, leaves of the present season's rosette(s) (excluding the central juvenile leaves) deciduous by late summer dormancy. *Leaves* green, oblanceolate, incurved, transversely gull-winged with an abaxial longitudinal prominent mid-vein in T.S., 1.8–2.5 cm long, 0.6–0.8 mm wide near the base, gradually dilated to 1.8–2 mm wide near the apex, c. 0.3 mm thick, margins hyaline, serrulate, 0.1–0.15 mm wide, mucro translucent white, 2.5–3 mm long. *Scape* glabrous; bracts absent. *Inflorescence* racemose, pedicels 3–4 mm long, inflorescence densely covered with non-glandular trichomes, with a few, scattered glandular hairs, non-glandular trichomes translucent-white 0.1–0.2 mm long, scattered translucent-white glandular trichomes 0.2–0.3 mm long tipped with blackish maroon glands; floral bracts ovate, 2.5–3 mm long, 0.8–1.2 mm wide, apical mucro translucent-white, 0.5–0.8 mm

long, margin hyaline, serrulate; bracteoles similar, 2–3 mm long, 0.5–0.7 mm wide. *Hypanthium* dark bronze-green, narrowly oblong at anthesis, 9–12 mm long, 1.2–1.4 mm wide, densely covered with non-glandular trichomes, with a few, scattered glands, non-glandular trichomes translucent-white, 0.1–0.2 mm long, scattered translucent-white glandular trichomes 0.2–0.3 mm long tipped with blackish maroon glands. *Calyx* with 2 lobes connate almost to their apex, 3 lobes free to base, 2.5–3 mm long, margins hyaline, mostly entire, densely covered with similar hairs and glands to those on the hypanthium. *Corolla* white, abaxial surface mostly red wine-coloured with a thin, pale yellow margin, glandular with scattered translucent trichomes tipped with blackish maroon glands; lobes vertically paired; anterior lobes 5.5–6.5 mm long, 2–3 mm wide, with yellowish green and reddish marks near the base; posterior lobes 6.5–7.5 mm long, 3.5–4 mm wide, with yellowish green and reddish marks near the base. *Labellum* boss green,  $\pm$  orbicular, c. 1 mm long, c. 0.8 mm wide, smooth, basal appendages 2, lateral, yellowish green, subulate, c. 0.5 mm long, c. 0.3 mm wide at the base, papillose; margins yellowish green with a reddish beard, papillose, bearing glandular trichomes c. 0.1 mm long. *Throat* yellowish green with 3 pearlescent squares (?pseudo-nectaries), appendages absent. *Gynostemium* c. 17 mm long, reddish, torus yellowish green; anthers reddish, positioned c. 45° to the gynostemium, with very short, translucent-white to -pale red moniliform hairs along the margins; pollen pale yellow; stigmas 2, obovoid, one projected above, the other projected below between the spent vertical anthers, c. 0.5 mm long. *Capsule* obovoid, 9–12 mm long, 1.8–2 mm wide. *Seeds*  $\pm$  turbinate, papillose, 0.5–0.55 mm long, 0.4–0.5 mm wide with irregular longitudinal ridges and grooves, testa dark reddish brown. (Figure 15)

*Diagnostic features.* *Stylidium vinosum* is distinguished from other members of the *S. piliferum* complex by its: narrowly oblong hypanthium and calyx lobes being densely covered with non-glandular trichomes, with a few, scattered glands and scattered translucent-white glandular trichomes tipped with blackish maroon glands; abaxial corolla surface having large, red wine-coloured markings covering the central parts of each lobe.

*Selected specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 3 Dec. 2008, *A. Crawford* 1907 (PERTH); Oct. 1952, *R. Erickson s.n.* (PERTH); 2 Oct. 1947, *C.A. Gardner* 8713 (PERTH); 18 Sep. 2008, *M. Hislop* WW226 & *P. Lewis* (PERTH); 29 Sep. 2007, *F. Hort* 3050 & *B. Hort* (PERTH); 21 Sep. 1991, *A. Lowrie* 327 (MEL, PERTH); 21 Sep. 1991, *A. Lowrie* 329 (PERTH); 20 Oct. 2011, *J.A. Wege* 1869 (PERTH); 23 Sep. 2007, *J.A. Wege* 1402 & *B.P. Miller* (PERTH).

*Vernacular name.* Julimar Triggerplant (here designated).

*Distribution and habitat.* Occurs throughout the Jarrah Forrest. Grows in white or grey sand over laterite soils in jarrah and wandoo forest as well as red-brown clayey loam over laterite in open wandoo woodland with *Acacia* species.

*Flowering period.* October to November.

*Conservation status.* Listed by Smith (2017) as Priority One under Conservation Codes for Western Australian Flora, under the name *S. sp.* Dewars Pool (K.F. Kenneally 11400).

*Etymology.* The epithet *vinosum* is from the Latin *vinosus* (wine-coloured), in reference to the purplish red-coloured abaxial surface of the corolla lobes.

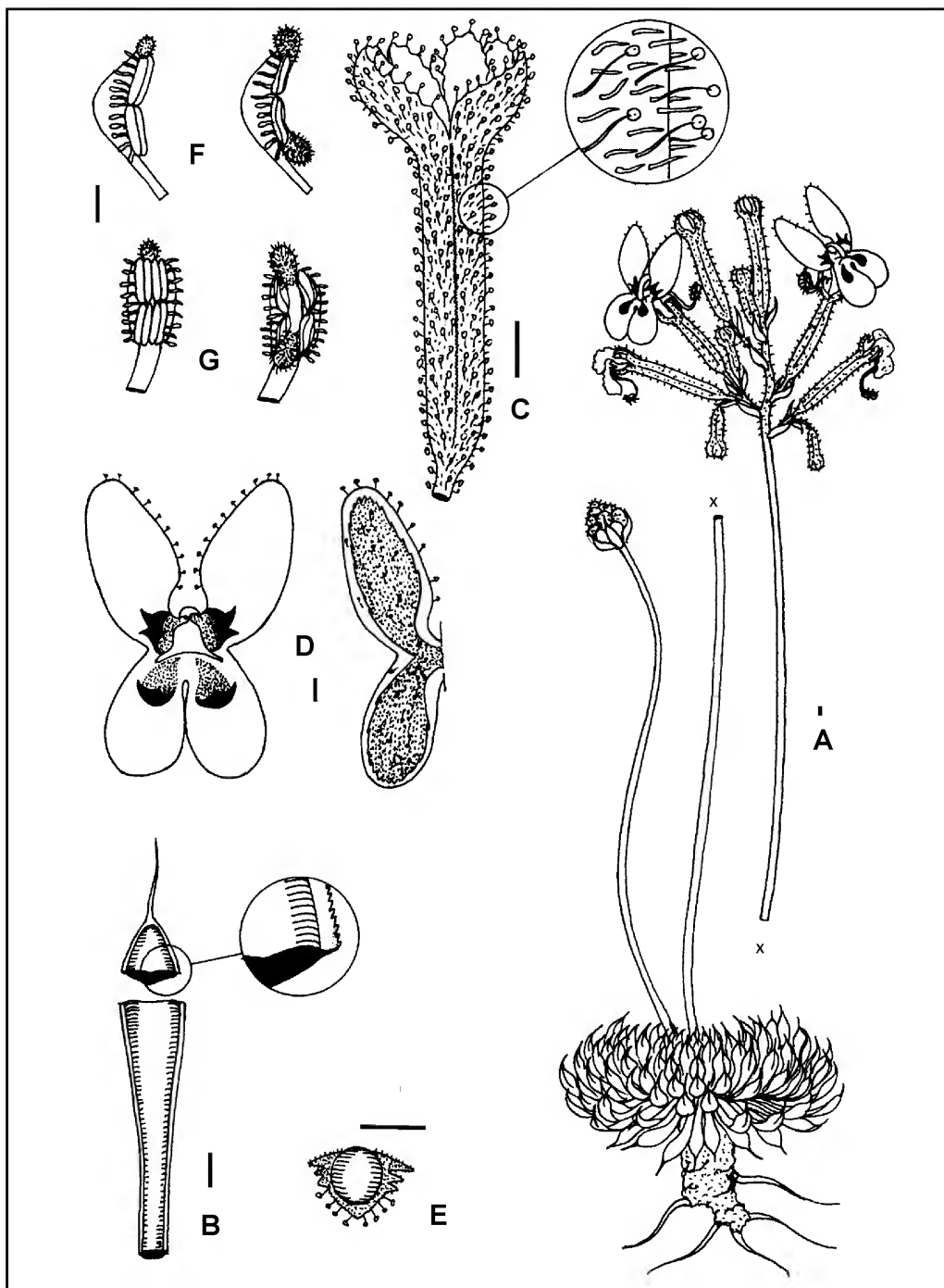


Figure 15. *Stylidium vinosum*. A – habit of flowering plant; B – leaf, and enlarged section (inset); C – hypanthium and calyx lobes, with detail of indumentum (inset); D – corolla (left), and abaxial surface showing red region (right); E – labellum; F – lateral view of gynostemium tip showing anthers (left), and with the stigmas grown out (right); G – adaxial view of gynostemium tip showing anthers (left), with the stigmas grown out (right). Scale bar = 1 mm. Drawn by Allen Lowrie from A. Lowrie 329.

*Notes.* *Stylidium vinosum* grows near *S. bindoon* at one location in the Julimar Conservation Park: *S. vinosum* only grows here in a white sand patch with jarrah c. 2 hectares in area; *S. bindoon* grows nearby in sand and laterite soils with wandoo forest. Examination of the area showed each species was restricted to its preferred soil type. In one area where the two soil types converged each species was shown not to grow in the other's habitat.

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## Referees for Volume 28

The assistance of referees in providing expert review of papers submitted to *Nuytsia* is gratefully acknowledged. The referees consulted for Volume 28 include those listed below and a further five anonymous reviewers. Each paper was also refereed internally by *Nuytsia* Editorial Committee members.

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## **CONSERVATION CODES**

### **for Western Australian Flora and Fauna**

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Specially protected fauna or flora are species\* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

#### **T Threatened species**

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

**Threatened fauna** is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Wildlife Conservation Act.

**Threatened flora** is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

#### **CR Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

#### **EN Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

#### **VU Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

#### **EX Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual

has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

## **IA Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

## **CD Conservation dependent fauna**

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

## **OS Other specially protected fauna**

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

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## **P Priority species**

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

### **1 Priority 1: Poorly-known species**

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

## **2 Priority 2: Poorly-known species**

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

## **3 Priority 3: Poorly-known species**

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

## **4 Priority 4: Rare, Near Threatened and other species in need of monitoring**

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

\*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).



